# NCERT

# CHAPTER WISE TOPIC WISE

## LINE BY LINE QUESTIONS

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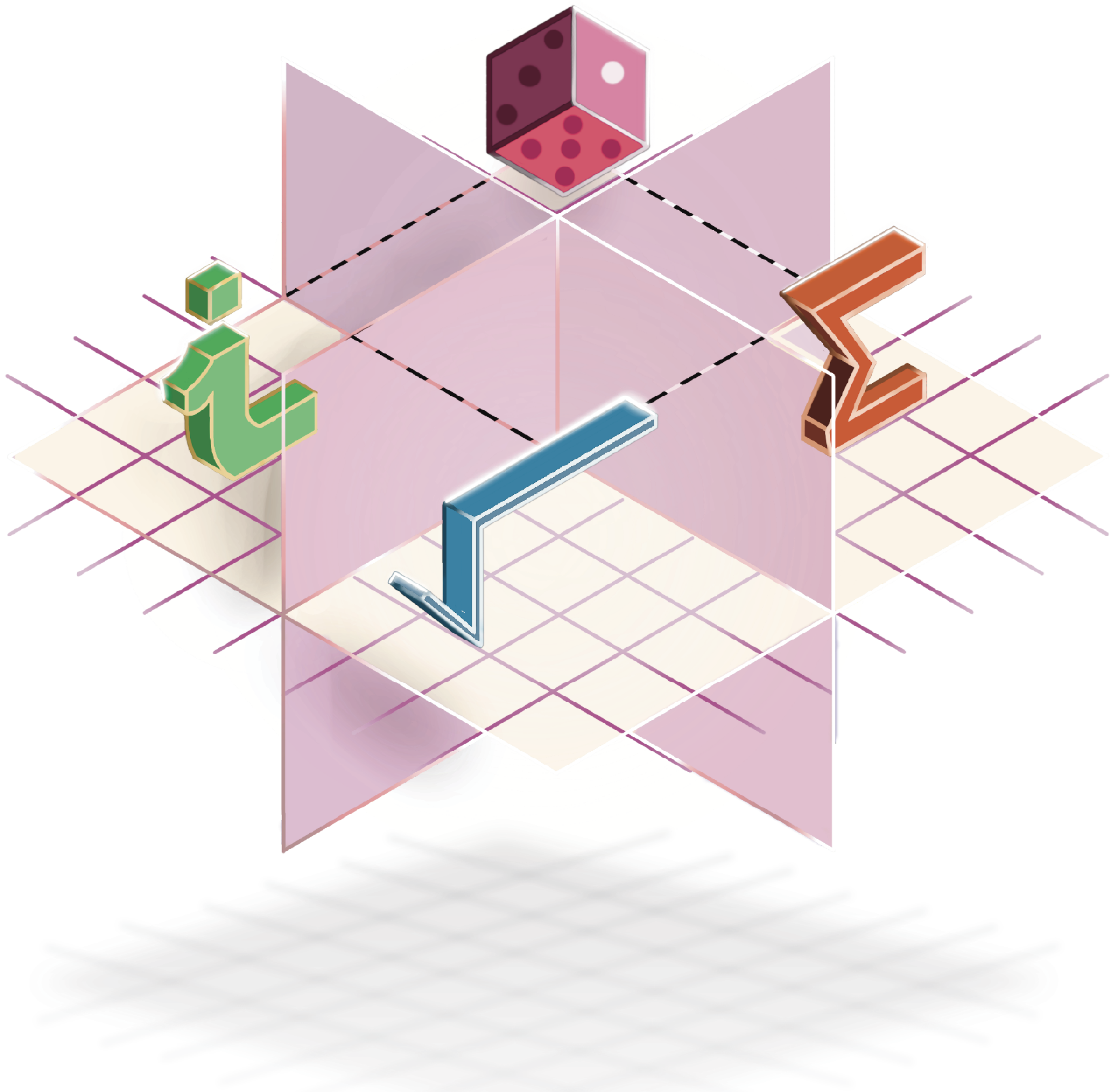
# Mathematics

Class 11



# 12

# BINOMIAL THEOREM

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## 1. BINOMIAL THEOREM

If a, b $\in$ R and n $\in$ N, then

$(a + b)^n = {}^nC_0\, a^n b^0 + {}^nC_1\, a^{n-1}\, b^1 + {}^nC_2\, a^{n-2} b^2 + ... + {}^nC_n\, a^0 b^n$

**REMARKS :**

1. If the index of the binomial is n then the expansion contains n + 1 terms.
2. In each term, the sum of indices of a and b is always n.
3. Coefficients of the terms in binomial expansion equidistant from both the ends are equal.
4. $(a-b)^n = {}^nC_0 a^n b^0 - {}^nC_1 a^{n-1}\, b^1 + {}^nC_2 a^{n-2} b^{2-} ... + (-1)^n\, {}^nC_0 a^0 b^n$.

## 2. GENERAL TERM AND MIDDLE TERMS IN EXPANSION OF (a + b)$^n$

$t_{r+1} = {}^nC_r\, a^{n-r}\, b^r$

$t_{r+1}$ is called a general term for all r $\in$ W and $0 \le r \le n$. Using this formula we can find any term of the expansion.

**MIDDLE TERM (S) :**

1. In $(a + b)^n$ if n is even then the number of terms in the expansion is odd. Therefore there is only one middle term and it is $\left(\frac{n+2}{2}\right)^{th}$ term.
2. In $(a + b)^n$, if n is odd then the number of terms in the expansion is even. Therefore there are two middle terms and those are $\left(\frac{n+1}{2}\right)^{th}$ and $\left(\frac{n+3}{2}\right)^{th}$ terms.

## 3. NUMERICALLY GREATEST TERM

The term with greatest numerical/absolute value in the expansion of $(a + b)^n$ can be found in following way

(i) Find the value of $\dfrac{n+1}{1+\left|\frac{a}{b}\right|}$

(ii) If it equals an integer, say m, then $t_m$ and $t_{m+1}$ are numerically greatest terms.

(iii) If it is not an integer, then $t_{m+1}$ is numerically greatest term (where m is the integral part of $\dfrac{n+1}{1+\left|\frac{a}{b}\right|}$ ).

Also middle terms in binomial expansions have the greatest binomial coefficients. (${}^nC_0$, ${}^nC_1$, ${}^nC_2$........ ${}^nC_n$ are called Binomial Coefficients).

## 4. BINOMIAL COEFFICENTS

The coefficients ${}^nC_0$, ${}^nC_1$, ${}^nC_2$,..., ${}^nC_n$ in the expansion of $(a+b)^n$ are called the binomial coefficients and denoted by $C_0$, $C_1$, $C_2$, ....., $C_n$ respectively

Now

$(1 + x)^n = {}^nC_0 x^0 + {}^nC_1 x^1 + {}^nC_2 x^2 + ... + {}^nC_n x^n$ ..... (i)

Put x = 1.

$(1 + 1)^n = {}^nC_0 + {}^nC_1 + {}^nC_2 + ... + {}^nC_n$

$\therefore$ $2^n = {}^nC_0 + {}^nC_1 + {}^nC_2 + ... + {}^nC_n$

$\therefore$ ${}^nC_0 + {}^nC_1 + {}^nC_2 + ... + {}^nC_n = 2^n$

$\therefore$ $C_0 + C_1 + C_2 + ... + C_n = 2^n$

$\therefore$ The sum of all binomial coefficients is $2^n$.

Put x = –1, in equation (i),

$(1-1)^n = {}^nC_0 - {}^nC_1 + {}^nC_2 - ... + (-1)^n\, {}^nC_n$

$\therefore$ $0 = {}^nC_0 - {}^nC_1 + {}^nC_2 - ... + (-1)^n\, {}^nC_n$

$\therefore$ ${}^nC_0 - {}^nC_1 + {}^nC_2 - {}^nC_3 + .... + (-1)^n\, {}^nC_n = 0$

$\therefore$ ${}^nC_0 + {}^nC_2 + {}^nC_4 + ... = {}^nC_1 + {}^nC_3 + {}^nC_5 + ...$

$\therefore$ $C_0 + C_2 + C_4 + ... = C_1 + C_3 + C_5 + ...$

$C_0, C_2, C_4, ...$ are called as even coefficients

$C_1, C_3, C_5 ...$ are called as odd coefficients

Let $C_0 + C_2 + C_4 + ... = C_1 + C_3 + C_5 + ... = k$

Now $C_0 + C_1 + C_2 + C_3 + ... + C_n = 2^n$

$\therefore$ $(C_0 + C_2 + C_4 + ...) + (C_1 + C_3 + C_5 ...) = 2^n$

$\therefore$ $k + k = 2^n$

$2k = 2^n$

$\therefore$ $k = \dfrac{2^n}{2}$

$\therefore$ $k = 2^{n-1}$

$\therefore$ $C_0 + C_2 + C_4 + ... = C_1 + C_3 + C_5 + ... = 2^{n-1}$

$\therefore$ The sum of even coefficients = The sum of odd coefficients $= 2^{n-1}$

### Properties of Binomial Coefficient

(i) $C_0 + C_1 + C_2 + ........... + C_n = 2^n$

(ii) $C_0 - C_1 + C_2 - ........... + (-1)^n C_n = 0$

(iii) $C_0 + C_2 + C_4 + ........... = C_1 + C_3 + C_5 + ......... = 2^{n-1}$.

(iv) ${}^nC_{r_1} = {}^nC_{r_2} \Rightarrow r_1 = r_2 \text{ or } r_1 + r_2 = n$

(v) ${}^nC_r + {}^nC_{r-1} = {}^{n+1}C_r$

(vi) $r\,{}^nC_r = n\,{}^{n-1}C_{r-1}$

### Some Important Results

(i) Differentiating $(1 + x)^n = C_0 + C_1x + C_2x^2 + ....... + C_nx^n$, on both sides we have,

$n(1 + x)^{n-1} = C_1 + 2C_2x + 3C_3x^2 + ....... + nC_nx^{n-1}$ ....(1)

Put $x = 1$

$\Rightarrow$ $n2^{n-1} = C_1 + 2C_2 + 3C_3 + ........ + nC_n$

Put $x = -1$

$\Rightarrow$ $0 = C_1 - 2C_2 + ........ + (-1)^{n-1} nC_n$.

Differentiating (1) again and again we will have different results.

(ii) Integrating $(1 + x)^n$, we have,

$$\frac{(1+x)^{n+1}}{n+1} + C = C_0x + \frac{C_1x^2}{2} + \frac{C_2x^3}{3} + ......... + \frac{C_nx^{n+1}}{n+1}$$

(where C is a constant)

Put $x = 0$, we get $C = -\dfrac{1}{(n+1)}$

Therefore

$$\frac{(1+x)^{n+1} - 1}{n+1} = C_0x + \frac{C_1x^2}{2} + \frac{C_2x^3}{3} + ......... + \frac{C_nx^{n+1}}{n+1} \quad ...(2)$$

Put $x = 1$ in (2) we get

$$\frac{2^{n+1} - 1}{n+1} = C_0 + \frac{C_1}{2} + ......... + \frac{C_n}{n+1}$$

Put $x = -1$ in (2) we get,

$$\frac{1}{n+1} = C_0 - \frac{C_1}{2} + \frac{C_2}{3} - ............$$

## 5. BINOMIAL THEOREM FOR ANY INDEX

If n is any real number and $|x| < 1$ then

$$(1 + x)^n = 1 + nx + \frac{n(n-1)}{2!}x^2 + \frac{n(n-1)(n-2)}{3!}x^3 + ...$$

Here there are infinite number of terms in the expansion, The general term is given by

$$t_{r+1} = \frac{n(n-1)(n-2)...(n-r+1)x^r}{r!}, r \geq 0$$

**NOTES :**

(i) Expansion is valid only when $-1 < x < 1$

(ii) ${}^nC_r$ can not be used because it is defined only for natural number, so ${}^nC_r$ will be written as

$$\frac{n(n-1).........(n-r+1)}{r!}$$

(iii) As the series never terminates, the number of terms in the series is infinite.

(iv) If first term is not 1, then make it unity in the following way. $(a + x)^n = a^n(1 + x/a)^n$ if $\left|\dfrac{x}{a}\right| < 1$

**NOTES :**

While expanding $(a + b)^n$ where n is a negative integer or a fraction, reduce the binomial to the form in which the first term is unity and the second term is numerically less than unity.

Particular expansion of the binomials for negative index, $|x| < 1$

1. $\frac{1}{1+x} = (1+x)^{-1}$

   $= 1 - x + x^2 - x^3 + x^4 - x^5 + .....$

2. $\frac{1}{1-x} = (1-x)^{-1}$

   $= 1 + x + x^2 + x^3 + x^4 + x^5 + .....$

3. $\frac{1}{(1+x)^2} = (1+x)^{-2}$

   $= 1 - 2x + 3x^2 - 4x^3 + .....$

4. $\frac{1}{(1-x)^2} = (1-x)^{-2}$

   $= 1 + 2x + 3x^2 + 4x^3 + .....$

## 6. MULTINOMIAL EXPANSION

In the expansion of $(x_1 + x_2 + ........ + x_n)^m$ where $m, n \in N$ and $x_1, x_2, ..........., x_n$ are independent variables, we have

(i) Total number of terms $= {}^{m+n-1}C_{n-1}$

(ii) Coefficient of $x_1^{r_1} x_2^{r_2} x_3^{r_3} .........x_n^{r_n}$ (where $r_1 + r_2 + .......... + r_n = m, r_i \in N \cup \{0\}$ is $\frac{m!}{r_1! r_2! .......r_n!}$

(iii) Sum of all the coefficients is obtained by putting all the variables $x_1$ equal to 1.

# SOLVED EXAMPLES

**Example – 1**

Expand

(i) $(2x^2+3)^4$ (ii) $\left(2x^2-\frac{1}{x}\right)^6$

**Sol.** **(i)** $(2x^2+3)^4=$

$={}^4C_0(2x^2)^4(3)^0+{}^4C_1(2x^2)^3(3)^1+{}^4C_2(2x^2)^2$

$(3)^2+{}^4C_3(2x^2)^1(3)^3+{}^4C_4(2x^2)^0(3)^4$

$=(1)\,16x^8(1)+4\,(8x^6)\,(3)+6\,(4x^4)\,(9)+4\,(2x^2)\,27+(1)\,(1)\,81$

$$\because \left\{\begin{matrix} {}^4C_0={}^4C_4=1,\ {}^4C_1={}^4C_3=4 \\ {}^4C_2=\frac{4!}{2!\,2!}=\frac{4\times3\times2!}{2!\times2}=6 \end{matrix}\right\}$$

$=16x^8+96x^6+216x^4+216x^2+81$

**(ii)** $\left(2x^2-\frac{1}{x}\right)^6={}^6C_0\,(2x^2)^6\left(\frac{1}{x}\right)^0-$

${}^6C_1(2x^2)^5\left(\frac{1}{x}\right)^1+{}^6C_2\,(2x^2)^4\left(\frac{1}{x}\right)^2-$

${}^6C_3\,(2x^2)^3\left(\frac{1}{x}\right)^3+{}^6C_4\,(2x^2)^2$

$\left(\frac{1}{x}\right)^4-{}^6C_5\,(2x^2)\left(\frac{1}{x}\right)^5+{}^6C_6\,(2x^2)^0\left(\frac{1}{x}\right)^6$

$=(1)\,64x^{12}(1)-(6)\,(32)\,x^{10}\times\frac{1}{x}+15\,(16)\,x^8\times\frac{1}{x^2}$

$-20\times 8x^6\times\frac{1}{x^3}+15(4)\,x^4\times\frac{1}{x^4}$

$-6(2x^2)\times\frac{1}{x^5}+(1)\,(1)\frac{1}{x^6}$

$$\because \left\{\begin{matrix} {}^6C_0={}^6C_6=1,\ {}^6C_1={}^6C_5=6 \\ {}^6C_2=\frac{6!}{2!4!}=\frac{6\times5\times4!}{2\times4!}=15 \\ {}^6C_3=\frac{6!}{3!3!}=\frac{6\times5\times4\times3!}{3\times2\times3!}=20 \end{matrix}\right\}$$

$=64x^{12}-192x^9+240x^6-160x^3+60-\frac{12}{x^3}+\frac{1}{x^6}$

**Example – 2**

Expand $(1+x+x^2)^3$.

**Sol.** Let $y=x+x^2$. Then,

$(1+x+x^2)^3=(1+y)^3={}^3C_0+{}^3C_1\,y+{}^3C_2y^2+{}^3C_3y^3$

$=1+3y+3y^2+y^3=1+3\,(x+x^2)+3\,(x+x^2)^2+(x+x^2)^3$

$=1+3\,(x+x^2)+3(x^2+2x^3+x^4)+\{{}^3C_0x^3\,(x^2)^0+{}^3C_1\,x^{3-1}\,(x^2)^1$

$+{}^3C_2x^{3-2}\,(x^2)^2+{}^3C_3\,x^0\,(x^2)^3\}$

$=1+3\,(x+x^2)+3(x^2+2x^3+x^4)+(x^3+3x^4+3x^5+x^6)$

$=x^6+3x^5+6x^4+7x^3+6x^2+3x+1$

**Example – 3**

Prove that $(\sqrt{5}+1)^5-(\sqrt{5}-1)^5=352$

**Sol.** $(\sqrt{5}+1)^5-(\sqrt{5}-1)^5=$

$$=\left[\begin{array}{c}{}^5C_0(\sqrt{5})^5+{}^5C_1(\sqrt{5})^4(1)+{}^5C_2(\sqrt{5})^3(1)^2\\ +{}^5C_3(\sqrt{5})^2(1)^3+{}^5C_4(\sqrt{5})(1)^4\\ +{}^5C_5(\sqrt{5})^0(1)^5\end{array}\right]$$

$$-\left[\begin{array}{c}{}^5C_0(\sqrt{5})^5-{}^5C_1(\sqrt{5})^4(1)+{}^5C_2(\sqrt{5})^3(1)^2\\ -{}^5C_3(\sqrt{5})^2(1)^3+{}^5C_4(\sqrt{5})(1)^4\\ -{}^5C_5(\sqrt{5})^0(1)^5\end{array}\right]$$

$$=2\left[{}^5C_1 5^2+{}^5C_3.5+{}^5C_5\right]$$

$$=2[5\times25+10\times5+1]$$

$$\left\{\begin{array}{l}{}^5C_0={}^5C_5=1;\ {}^5C_4=5;\\ {}^5C_2={}^5C_3=\frac{5.4}{2.1}=10;\ {}^5C_1=5\end{array}\right\}$$

$=2[125+51]$

$=352$

**Example – 4**

Using binomial theorem compute $(99)^5$.

**Sol.** $(99)^5=(100-1)^5={}^5C_0(100)^5-{}^5C_1(100)^4+{}^5C_2(100)^3$
$-{}^5C_3(100)^2+{}^5C_4(100)^1-{}^5C_5(100)^0$

$=(100)^5-5\times(100)^4+10\times(100)^3-10\times(100)^2+5\times100-1$

$=10^{10}-5\times10^8+10^7-10^5+5\times10^2-1$

$=(10^{10}+10^7+5\times10^2)-(5\times10^8+10^5+1)$

$=10010000500-500100001=9509900499$

**Example – 5**

Use the binomial theorem to find the exact value of $(10.1)^5$.

**Sol.** $(10.1)^5=(10+0.1)^5$

$=10^5+{}^5C_1\,10^4(.1)+{}^5C_2\,10^3(.1)^2+{}^5C_3\,10^2(.1)^3$
$+{}^5C_4\,10(.1)^4+{}^5C_5(.1)^5$

$=100000+5\times10^4(.1)+10\times(10^3)(.01)+10\times10^2(.001)$
$+5\times10(.0001)+0.00001$

$=100000+5000+100+1+0.005+0.00001=105101.00501$

**Example – 6**

Prove that $\sum_{r=1}^{5}{}^5C_r=31$

**Sol.** $\sum_{r=1}^{5}{}^5C_r={}^5C_1+{}^5C_2+{}^5C_3+{}^5C_4+{}^5C_5$

$$=\frac{5!}{1!4!}+\frac{5!}{2!3!}+\frac{5!}{3!2!}+\frac{5!}{4!1!}+\frac{5!}{5!0!}$$

$$=\frac{5}{1}+\frac{5.4}{2}+\frac{5.4}{2}+\frac{5}{1}+1$$

$=5+10+10+5+1=31$

**Example – 7**

Find n, if ${}^nC_6:{}^{n-3}C_3=33:4$.

**Sol.** Given, ${}^nC_6:{}^{n-3}C_3=33:4$.

$$\therefore\ \frac{n!}{6!(n-6)!}\times\frac{3!(n-3-3)!}{(n-3)!}=\frac{33}{4}$$

$$\text{or}\ \frac{n!}{(n-3)!}.\frac{3!}{6!}=\frac{33}{4}\ \text{or}\ \frac{n(n-1)(n-2)}{6.5.4}=\frac{33}{4}$$

or $n(n-1)(n-2)=6.5.33=11.3.3.2.5$

or $n(n-1)(n-2)=11.(3.3).(2.5)=11.10.9$ $\therefore$ $n=11$

**Example – 8**

If ${}^nC_8={}^nC_6$ determine n and hence ${}^nC_2$.

**Sol.** Given, ${}^nC_8={}^nC_6$

We know that ${}^nC_x={}^nC_y$ then $x=y$ or $x+y=n$

$\Rightarrow n=8+6$

$\Rightarrow$ $n=14$

Now ${}^nC_2={}^{14}C_2=\frac{14\times13}{2!}=91$

**Example – 9**

If ${}^{15}C_{3r} = {}^{15}C_{r+3}$, find r.

**Sol.** We know that if ${}^{n}C_{x} = {}^{n}C_{y}$, then x = y or x + y = n

$${}^{15}C_{3r} = {}^{15}C_{r+3}$$

$\therefore$ Either $3r = r+3 \quad \Rightarrow \quad r = \frac{3}{2}$,

which is not possible, since r is an integer.

or $3r + r + 3 = 15 \quad \Rightarrow \quad r = 3$.

Hence r = 3.

**Example – 10**

Find the third term in the expansion of $\left(2x^2 + \frac{3}{2x}\right)^8$

**Sol.** Let $a = 2x^2$, $b = \frac{3}{2x}, n = 8$

For third term, r = 2

$t_{r+1} = {}^{n}C_{r}\, a^{n-r}\, b^{r}$

$= {}^{8}C_{2}\,(2x^2)^{8-2}\left(\frac{3}{2x}\right)^2$

$= \frac{8.7.6!}{2!6!}(2x^2)^6 \times \frac{9}{4x^2} \left[\because {}^{8}C_{2} = \frac{8!}{2!6!}\right]$

$= \frac{8.7}{2} \times 2^6 \times x^{12} \times \frac{9}{4x^2}$

$= 63 \times 64x^{10} = 4032x^{10}$

**Example – 11**

Find the fifth term in the expansion of $\left(x^2 - \frac{4}{x^3}\right)^{11}$

**Sol.** Let, $a = x^2$, $b = \frac{-4}{x^3}, n = 11$

For fifth term, r = 4

$\therefore \quad t_{r+1} = {}^{n}C_{r}\, a^{n-r} .\, b^{r}$

$\therefore \quad t_5 = {}^{11}C_4\,(x^2)^{11-4}\left(\frac{-4}{x^3}\right)^4$

$\therefore \quad t_5 = \frac{11!}{4!\,7!}(x^2)^7 \times \frac{4^4}{x^{12}}$

$\therefore \quad t_5 = \frac{11\times10\times9\times8\times7!}{4\times3\times2\times7!}x^{14} \times \frac{256}{x^{12}}$

$\therefore \quad t_5 = 330 \times 256x^2 \qquad \Rightarrow t_5 = 84480x^2$

**Example – 12**

Given that the 4th term in the expansion of $\left(px + \frac{1}{x}\right)^n$ is $\frac{5}{2}$, find n and p.

**Sol.** Given expansion is $\left(px + \frac{1}{x}\right)^n$

Given, $T_4 = \frac{5}{2}$

$\therefore \quad {}^{n}C_3\,(px)^{n-3}\left(\frac{1}{x}\right)^3 = \frac{5}{2}$

$\Rightarrow \quad {}^{n}C_3\, p^{n-3}\, x^{n-3} . \frac{1}{x^3} = \frac{5}{2}$

$\Rightarrow \quad \frac{n!}{3!(n-3)!}.p^{n-3}\, x^{n-6} = \frac{5}{2}$ ...(1)

Since R.H.S. of (1) is independent of x,

therefore n – 6 = 0 $\quad \therefore \quad$ n = 6.

From (1), $\quad \frac{6!}{3!\,3!}.p^3 = \frac{5}{2}$

$\Rightarrow \quad 20p^3 = \frac{5}{2}$

$\Rightarrow \quad p^3 = \frac{1}{8} = \left(\frac{1}{2}\right)^3 \quad \therefore \; p = \frac{1}{2}.$

Hence n = 6 and $p = \frac{1}{2}$.

**Example – 13**

Given positive integers $r > 1$, $n > 2$ and the coefficient of $(3r)^{th}$ and $(r+2)^{th}$ terms in the binomial expansion of $(1+x)^{2n}$ are equal. Then :

(a) $n = 2r$ (b) $n = 2r + 1$

(c) $n = 3r$ (d) none of these

**Ans.** (a)

**Sol.** In the expansion $(1+x)^{2n}$, $t_{3r} = {}^{2n}C_{3r-1}\,(x)^{3r-1}$

and $t_{r+2} = {}^{2n}C_{r+1}\,(x)^{r+1}$

Since, binomial coefficients of $t_{3r}$ and $t_{r+2}$ are equal.

$\therefore\ {}^{2n}C_{3r-1} = {}^{2n}C_{r+1}$

$\Rightarrow 3r - 1 = r + 1$ or $2n = (3r-1) + (r+1)$

$\Rightarrow 2r = 2$ or $2n = 4r$

$\Rightarrow r = 1$ or $n = 2r$

But $r > 1$

$\therefore$ We take, $n = 2r$

**Example – 14**

If the coefficients of three consecutive terms in the expansion of $(1+a)^n$ are in the ratio 1 : 7 : 42, find n.

**Sol.** Let the three consecutive terms in the expansion of $(1+a)^n$ be rth, $(r+1)$th and $(r+2)$th terms respectively.

In the expansion of $(1+a)^n$,

coefficient of rth term $= {}^nC_{r-1}$,

coefficient of $(r+1)$th term $= {}^nC_r$.

coefficient or $(r+2)$th term $= {}^nC_{r+1}$

Given, ${}^nC_{r-1} : {}^nC_r : {}^nC_{r+1} = 1 : 7 : 42$.

$$\therefore\ \frac{{}^nC_{r-1}}{{}^nC_r} = \frac{1}{7}$$

$$\Rightarrow \frac{n!}{(r-1)!(n-r+1)!}\cdot\frac{r!(n-r)!}{n!} = \frac{1}{7}$$

$$\Rightarrow \frac{r}{n-r+1} = \frac{1}{7}$$

$\Rightarrow 7r = n - r + 1$

$\Rightarrow n - 8r = -1$ ............ (1)

$$\text{And } \frac{{}^nC_r}{{}^nC_{r+1}} = \frac{7}{42}$$

$$\Rightarrow \frac{n!}{r!(n-r)!}\cdot\frac{(r+1)!(n-r-1)!}{n!} = \frac{1}{6}$$

$$\Rightarrow \frac{r+1}{n-r} = \frac{1}{6}$$

$\Rightarrow 6r + 6 = n - r \quad \therefore\ n - 7r = 6$ ............ (2)

Now, (2) – (1) $\Rightarrow r = 7$

From (1), $n = 55$.

**Example – 15**

If in the expansion of $(1+x)^n$, the coefficients of 14th, 15th and 16th terms in A.P. find n.

**Sol.** The coefficients of 14th, 15th and 16th tems in the expansion of $(1+x)^n$ will be ${}^nC_{13}$, ${}^nC_{14}$ and ${}^nC_{15}$ respectively.

Given, ${}^nC_{13}$, ${}^nC_{14}$ and ${}^nC_{15}$ are in A.P.

$\therefore\ {}^nC_{14} - {}^nC_{13} = {}^nC_{15} - {}^nC_{14}$

or $2\,.\,{}^nC_{14} = {}^nC_{13} + {}^nC_{15}$

$$\text{or } 2.\frac{n!}{(14)!(n-14)!} = \frac{n!}{(13)!(n-13)!} + \frac{n!}{(15)!(n-15)!}$$

Multiplying both sides by 15! (n – 13)!, we get

$$2.\frac{15!(n-13)!}{14!(n-14)!} = \frac{15!(n-13)!}{13!(n-13)!} + \frac{15!(n-13)!}{15!(n-15)!}$$

or $2.15\,(n-13) = 15.14 + (n-13)(n-14)$

or $30n - 390 = 210 + n^2 - 27n + 182$

or $n^2 - 57n + 782 = 0$

or $(n-34)(n-23) = 0$

Hence $n = 23$ or $34$.

**Example – 16**

The term independent of x in $\left[\sqrt{\left(\frac{x}{3}\right)}+\sqrt{\left(\frac{3}{2x^2}\right)}\right]^{10}$ is:

(a) 1 (b) ${}^{10}C_1$

(c) 5/12 (d) none of these

**Ans.** (d)

**Sol.** $T_{r+1} = {}^{10}C_r\left(\sqrt{\frac{x}{3}}\right)^{10-r}\left(\sqrt{\frac{3}{2x^2}}\right)^r$

Equating x power to zero

$\frac{10-r}{2}-r=0$

$10-3r=0$

$\Rightarrow r=\frac{10}{3}$

Independent of 'x' term is not possible

**Example – 17**

Find the constant term (term independent of x) in the expansion of

(i) $\left(2x+\frac{1}{3x^2}\right)^9$ (ii) $\left(x-\frac{2}{x^2}\right)^{15}$

**Sol.** Let $a=2x,\ b=\frac{1}{3x^2}, n=9$

$t_{r+1}={}^nC_r\, a^{n-r}\,.\, b^r$

$t_{r+1}={}^9C_r(2x)^{9-r}\left(\frac{1}{3x^2}\right)^r$

$t_{r+1}={}^9C_r\,(2)^{9-r}\left(\frac{1}{3}\right)^r x^{-2r}.x^{9-r}$

$t_{r+1}={}^9C_r\,(2)^{9-r}\left(\frac{1}{3}\right)^r x^{9-3r}$

To get term independent of x, must have

$x^{9-3r}=x^0$

$9-3r=0 \quad \Rightarrow -3r=-9 \quad \Rightarrow r=3$

$\therefore\ {}^9C_3\,(2)^{9-3}\left(\frac{1}{3}\right)^3$

$\frac{9!}{3!6!}\times 2^6\times\frac{1}{27}=\frac{9\times8\times7\times6!}{3\times2\times6!}\times64\times\frac{1}{27}$

$=\frac{28\times64}{9}=\frac{1792}{9}$

Constant term independent of $x=\frac{1792}{9}$

**(ii)** Let $a=x,\ b=\frac{-2}{x^2}, n=15$

$t_{r+1}={}^nC_r\, a^{n-r}\,.\, b^r$

$t_{r+1}={}^{15}C_r(x)^{15-r}\left(\frac{-2}{x^2}\right)^r$

$t_{r+1}={}^{15}C_r(x)^{15-r}(-2)^r x^{-2r}$

$t_{r+1}={}^{15}C_r(-2)^r(x)^{15-3r}$

To get constant term independent of x,

$x^{15-3r}=x^0$

$15-3r=0 \quad \Rightarrow -3r=-15 \quad \Rightarrow r=5$

$\therefore\ {}^{15}C_5(-2)^5=\frac{15!}{5!10!}(-32)$

$=\frac{15\times14\times13\times12\times11\times10!}{5\times4\times3\times2\times10!}\times -32$

$=-77\times39\times32=-96096$

Constant term independent of $x=-96096$

**Example – 18**

Find the middle term (s) in the expansion of

(i) $\left(\frac{x}{y}+\frac{y}{x}\right)^{12}$ (ii) $\left(x^4-\frac{1}{x^3}\right)^{11}$

**Sol.** **(i)** Let $a=\frac{x}{y}, b=\frac{y}{x}, n=12$

n is even.

$\therefore \left(\frac{n+2}{2}\right)=\left(\frac{12+2}{2}\right)=\frac{14}{2}=7$

$7^{th}$ term is middle term,

$t_{r+1} = {}^nC_r a^{n-r} . b^r$

For 7th term, r = 6

$t_7 = {}^{12}C_6\left(\frac{x}{y}\right)^{12-6}\left(\frac{y}{x}\right)^6$

$t_7 = \frac{12!}{6!6!}\times\left(\frac{x}{y}\right)^6\times\left(\frac{y}{x}\right)^6$

$t_7 = \frac{12\times11\times10\times9\times8\times7\times6!}{6\times5\times4\times3\times2\times6!}$

$t_7 = 77\times12 = 924$

$\therefore$ Middle term = 924

**(ii)** Let $a = x^4$, $b=\frac{-1}{x^3}, n=11$

n is odd. $\left(\frac{n+1}{2}\right)=\left(\frac{11+1}{2}\right)=6,$

$\left(\frac{n+3}{2}\right)=\left(\frac{11+3}{2}\right)=7$

6th and 7th term are middle term,

$t_{r+1} = {}^nC_r a^{n-r} . b^r$

For $t_6$, r = 5

$t_6 = {}^{11}C_5 (x^4)^{11-5}\left(\frac{-1}{x^3}\right)^5$

$t_6 = \frac{11!}{5!\,6!}x^{24}\left(\frac{-1}{x^{15}}\right)$

$t_6 = \frac{11\times10\times9\times8\times7\times6!}{5\times4\times3\times2\times1\times6!}(-x^9)$

$= -462\,x^9$

For $t_7$, r = 6

$t_7 = {}^{11}C_6 (x^4)^{11-6}\left(\frac{-1}{x^3}\right)^6$

$t_7 = \frac{11!}{6!5!}x^{20}\times\frac{1}{x^{18}}$

$t_7 = \frac{11\times10\times9\times8\times7\times6!}{6!\times5\times4\times3\times2}x^2$

$t_7 = 11\times3\times2\times7 = 462x^2$

**Example – 19**

The middle term in expansion of $\left(x^2+\frac{1}{x^2}+2\right)^n$ is :

(a) $\frac{n!}{[(n/2)!]^2}$ (b) $\frac{2n!}{[(n/2)!]^2}$

(c) $\frac{1.3.5........(2n+1)}{n!}2^n$ (d) $\frac{(2n)!}{(n!)^2}$

**Ans.** (d)

**Sol.** Middle term in expansion of

$\left(x^2+\frac{1}{x^2}+2\right)^n = \left(x+\frac{1}{x}\right)^{2n}$

So, (n + 1)th term

$\Rightarrow {}^{2n}C_n = \frac{(2n)!}{n!n!}$

**Example – 20**

Find the middle terms(s) in the expansion of $\left(x^2+\frac{1}{x}\right)^7$

**Sol.** Let $a = x^2$, $b = \frac{1}{x}$, $n = 7$

n is odd.

$$\left(\frac{n+1}{2}\right)=\left(\frac{7+1}{2}\right)=4 \text{ and } \left(\frac{n+3}{2}\right)=\left(\frac{7+3}{2}\right)=5$$

4th and 5th terms are middle terms,

for $t_4$, $r = 3$

$t_{r+1} = {}^nC_r a^{n-r} . b^r$

$$t_4 = {}^7C_3 (x^2)^{7-3}\left(\frac{1}{x}\right)^3$$

$$t_4 = \frac{7!}{4!3!}\times(x^2)^4\times\frac{1}{x^3}$$

$$t_4 = \frac{7\times6\times5\times4!}{4!\times3\times2}\times x^8\times\frac{1}{x^3}$$

$t_4 = 35x^5$

For $t_5$, $r = 4$

$$t_5 = {}^7C_4\left(x^2\right)^{7-4}\left(\frac{1}{x}\right)^4$$

$$t_5 = \frac{7!}{4!3!}\times x^6\times\frac{1}{x^4}$$

$$t_5 = \frac{7\times6\times5\times4!}{4!\times3\times2}\times x^2 = 35x^2$$

**Example – 21**

Find the coefficient of $x^9$ in $(1 + 3x + 3x^2 + x^3)^{15}$.

**Sol.** $(1 + 3x + 3x^2 + x^3)^{15} = [(1 + x)^3]^{15} = (1 + x)^{45}$

$\therefore$ Coefficient of $x^9$ in $(1 + 3x + 3x^2 + x^3)^{15}$

= coefficient of $x^9$ in $(1 + x)^{45}$

$= {}^{45}C_9$ [Since in the expansion of $(1 + x)^n$, coefficient of $x^r = {}^nC_r$]

$$= \frac{45!}{9!36!}$$

**Example – 22**

Find the value of the expression ${}^{47}C_4 + \sum_{j=1}^{5} {}^{52-j}C_3$.

**Sol.** Given expression $= {}^{47}C_4 + \sum_{j=1}^{5} {}^{52-j}C_3$.

$= {}^{47}C_4 + ({}^{51}C_3 + {}^{50}C_3 + {}^{49}C_3 + {}^{48}C_3 + {}^{47}C_3)$

$= {}^{47}C_4 + ({}^{47}C_3 + {}^{48}C_3 + {}^{49}C_3 + {}^{50}C_3 + {}^{51}C_3)$

$= ({}^{47}C_4 + {}^{47}C_3) + ({}^{48}C_3 + {}^{49}C_3 + {}^{50}C_3 + {}^{51}C_3)$

$= {}^{48}C_4 + {}^{48}C_3 + {}^{49}C_3 + {}^{50}C_3 + {}^{51}C_3$ $[\because {}^nC_r + {}^nC_{r-1} = {}^{n+1}C_r]$

$= ({}^{48}C_4 + {}^{48}C_3) + ({}^{49}C_3 + {}^{50}C_3 + {}^{51}C_3)$

$= ({}^{49}C_4 + {}^{49}C_3) + ({}^{50}C_3 + {}^{51}C_3)$

$= ({}^{50}C_4 + {}^{50}C_3) + {}^{51}C_3 = {}^{51}C_4 + {}^{51}C_3 = {}^{52}C_4$.

**Example – 23**

The sum of coefficient in $(1 + x - 3x^2)^{2134}$ is

(a) –1 (b) 1

(c) 0 (d) $2^{2134}$

**Ans.** (b)

**Sol.** Sum of co-efficients can be obtained by substituting x = 1

$\therefore$ Sum of co-efficients $= (1 + 1 - 3)^{2134} = (-1)^{2134} = 1$

**Example – 24**

The sum of the coefficients in the expansion of $(6a - 5b)^n$, where n is a positive integer, is

(a) 1 (b) –1

(c) $2^n$ (d) $2^{n-1}$

**Ans.** (a)

**Sol.** Sum of coefficients we get when a = b = 1

$\Rightarrow (6 - 5)^n = 1$

**Example – 25**

Prove that $\sum_{r=0}^{n} 3^r \cdot {}^nC_r = 4^n$.

**Sol.** $(1+x)^n = {}^nC_0 x^0 + {}^nC_1 x + {}^nC_2 x^2 + \ldots + {}^nC_n x^n$

$\therefore \quad {}^nC_0 x^0 + {}^nC_1 x + {}^nC_2 x^2 + \ldots + {}^nC_n x^n = (1+x)^n \qquad \ldots(1)$

Now $\sum_{r=0}^{n} 3^r \cdot {}^nC_r$

$= {}^nC_0 3^0 + {}^nC_1 3^1 + {}^nC_2 3^2 + \ldots + {}^nC_n 3^n$

$= (1+3)^n$

$= 4^n$.

**Example – 26**

Numerically greatest term, in the expansion of $(8-5x)^{18}$, (where $x = 2/5$) is :

(a) $1623 \times 2^{24}$ (b) $1623 \times 2^{22}$

(c) $1623 \times 2^{23}$ (d) none of these

**Ans.** (d)

**Sol.** $(8-5x)^{18} = 8^{18}\left(1-\frac{5x}{8}\right)^{18}$, $a = 1, b = -\frac{5}{8}\times\frac{2}{5} = -\frac{1}{4}$

$$\frac{(n+1)|b|}{|b|+|a|} = \frac{19\times\frac{1}{4}}{\frac{5}{4}} = 3.8$$

$T_4$ is greatest term

$T_4 = {}^{18}C_3\, 8^{15}(-2)^3$, so it is negative

**Example – 27**

Show that $2^{4n} - 2^n(7n+1)$ is some multiple of the square of 14, where n is a postive integer.

**Sol.** $2^{4n} - 2^n(7n+1) = (16)^n - 2^n(7n+1)$

$= (2+14)^n - 2^n \cdot 7n - 2^n$

$= (2^n + {}^nC_1 2^{n-1} \cdot 14 + {}^nC_2 2^{n-2} \cdot 14^2 + \ldots + 14^n) - 2^n \cdot 7n - 2^n$

$= 14^2({}^nC_2 2^{n-2} + {}^nC_3 2^{n-3}\, 14 + \ldots + 14^{n-2})$

$+ (2^n + {}^nC_1 \cdot 2^{n-1} \cdot 14 - 2^n \cdot 7n - 2^n)$

$= 14^2({}^nC_2 2^{n-2} + {}^nC_3 2^{n-3} \cdot 14 + \ldots + 14^{n-2})$

$+ (2^n + n2^{n-1} \cdot 2 \cdot 7 - 2^n \cdot 7n - 2^n)$

$= 14^2({}^nC_2 \cdot 2^{n-2} + {}^nC_3 \cdot 2^{n-3} \cdot 14 + \ldots + 14^{n-2})$

This is divisible by $14^2$ i.e. by 196 for all positive integral value of n.

**Note :** If $n = 1$, ${}^nC_2 = 0$, ${}^nC_3 = 0$ etc.

$\therefore$ Given expression $= 14^2 \times 0 = 0$, which is divisible by 196.

**Example – 28**

Using binomial theorem, prove that $6^n - 5n$ always leaves the remainder 1 when divided by 25 for all positive integers n.

**Sol.** $6^n - 5n = (1+5)^n - 5n$

$= (1 + {}^nC_1 5 + {}^nC_2 5^2 + \ldots + {}^nC_n 5^n) - 5n$

$= (1 + n \cdot 5 + {}^nC_2 \cdot 5^2 + \ldots + {}^nC_n 5^n) - 5n$

$= 1 + {}^nC_2 5^2 + {}^nC_3 5^3 + \ldots + {}^nC_n 5^n$

$= 1 + 25({}^nC_2 + {}^nC_3 \cdot 5 + \ldots + {}^nC_n 5^{n-2})$

$= 1 + 25.k$ where k is a positive integer.

$\therefore$ When $6^n - 5n$ is divided by 25, remainder will be 1 for all positive integer n.

**Example – 29**

Which number is larger, $(1.2)^{4000}$ or 800 ?

**Sol.** $(1.2)^{4000} = (1+0.2)^{4000}$

$= {}^{4000}C_0 + {}^{4000}C_1(0.2) +$ sum of positive terms

$= 1 + 4000(0.2) +$ a positive number

$= 1 + 800 +$ a positive number

$> 800$

Hence $(1.2)^{4000} > 800$.

**Example – 30**

The coefficient of $x^n$ in expansion of $(1+x)(1-x)^n$ is

(a) $(n-1)$ (b) $(-1)^n(1-n)$

(c) $(-1)^{n-1}(n-1)^2$ (d) $(-1)^{n-1}n$

**Ans.** (b)

**Sol.** $(1+x)(1-x)^n = (1-x)^n + x(1-x)^n$

$\therefore$ Coefficient of $x^n$ is $= (-1)^n + (-1)^{n-1}\,{}^nC_1$

$= (-1)^n[1-n]$

**Example – 31**

The coefficient of $x^7$ in the expansion of $(1 - x - x^2 + x^3)^6$ is

(a) –132 (b) –144

(c) 132 (d) 144

**Ans.** (b)

**Sol.** $(1 - x - x^2 + x^3)^6 = ((1 - x)(1 - x^2))^6 = (1 - x)^6 (1 - x^2)^6$

$= (1 - {}^6C_1 x + {}^6C_2 x^2 - {}^6C_3 x^3 + {}^6C_4 x^4 - {}^6C_5 x^5 + {}^6C_6 x^6)$

$(1 - {}^6C_1 x^2 + {}^6C_2 x^4 - {}^6C_3 x^6 + {}^6C_4 x^8 - {}^6C_5 x^{10} + {}^6C_6 x^{12})$

Coeff. of $x^7 = (-{}^6C_1)(-{}^6C_3) + (-{}^6C_3)({}^6C_2) + (-{}^6C_5)(-{}^6C_1)$

$= 6.20 - 20 . 15 + 6 . 6 = 120 - 300 + 36 = -144$

**Example – 32**

If the coefficients of $x^3$ and $x^4$ in the expansion of $(1 + ax + bx^2)(1 - 2x)^{18}$ in powers of x are both zero, then (a, b) is equal to :

(a) $\left(16, \frac{272}{3}\right)$ (b) $\left(16, \frac{251}{3}\right)$

(c) $\left(14, \frac{251}{3}\right)$ (d) $\left(14, \frac{272}{3}\right)$

**Ans.** (a)

**Sol.** On expanding the given expression we get,

$\Rightarrow (1 + ax + bx^2)(1 - {}^{18}C_1 (2x) + {}^{18}C_2 (2x)^2 - {}^{18}C_3 (2x)^3 + \dots + {}^{18}C_{18} (2x)^{18})$

Coefficient of $x^3$,

$\Rightarrow -{}^{18}C_1 (2b) + {}^{18}C_2 (4a) - 8.\ {}^{18}C_3 = 0$

$\Rightarrow 51a = 3b + 544$ ..(1)

Similarly coefficient of $x^4$,

$\Rightarrow {}^{18}C_4 (2)^4 - {}^{18}C_3 . 8a + {}^{18}C_2 4b = 0$

$\Rightarrow 32a = 3b + 240$ ..(2)

On solving (1) and (2) we get,

$\Rightarrow a = 16$ and $b = \frac{272}{3}$

**Example – 33**

Find the term independent of x in $(1 + x)^m \left(1+\frac{1}{x}\right)^n$

**Sol.** Given expression $= (1+x)^m \left(1+\frac{1}{x}\right)^n = (1+x)^m \left(\frac{x+1}{x}\right)^n$

$= \frac{(1+x)^{m+n}}{x^n} = x^{-n}(1+x)^{m+n}$

∴ Required term independent of x

$=$ coefficient of $x^0$ in $x^{-n}(1 + x)^{m+n}$

$=$ coefficient of $x^n$ in $(1 + x)^{m+n}$

$= {}^{m+n}C_n = \frac{(m+n)!}{n!m!}$

[Since in the expansion of $(1 + x)^n$, co-efficient of $x^r = {}^nC_r$]

**Example – 34**

Find the coefficient of $x^5$ in the expansion of the product $(1 + 2x)^6 (1 - x)^7$.

**Sol.** $(1 + 2x)^6 = [1 + {}^6C_1 (2x) + {}^6C_2 (2x)^2 + {}^6C_3 (2x)^3 + {}^6C_4 (2x)^4 + {}^6C_5 (2x)^5 + {}^6C_6 (2x)^6]$ .....(1)

Again, $(1 - x)^7 = 1 - {}^7C_1 x + {}^7C_2 x^2 - {}^7C_3 x^3 + {}^7C_4 x^4 - {}^7C_5 x^5 + {}^7C_6 x^6 - {}^7C_7 x^7$

$= 1 - 7x + 21x^2 - 35x^3 + 35x^4 - 21x^5 + 7x^6 - x^7$ .....(2)

Now $(1 + 2x)^6 (1 - x)^7$

$= (1 + 12x + 60x^2 + 160x^3 + 240x^4 + 192x^5 + \dots)$

$\times (1 - 7x + 21x^2 - 35x^3 + 35x^4 - 21x^5 + \dots)$

∴ Required coefficient of $x^5$ in the product

$= 1 \times (-21) + 12 \times 35 + 60 \times (-35) + 160 \times 21 + 240 \times (-7) + 192 \times 1$

$= -21 + 420 - 2100 + 3360 - 1680 + 192 = 171$

**Example – 35**

Simplify first three terms in the expansion of the following

(i) $(1+2x)^{-4}$ (ii) $(5+4x)^{-1/2}$

**Sol. (i)** $(1+2x)^{-4}=$

$$1+(-4)(2x)+\frac{(-4)(-4-1)}{2!}(2x)^2+\ldots\ldots\ldots\ldots$$

$$=1-8x+\frac{(-4)(-5)}{2}(4x^2)+\ldots\ldots\ldots\ldots$$

$$=1-8x+40x^2+\ldots..$$

**(ii)** $(5+4x)^{\frac{-1}{2}}=5^{\frac{-1}{2}}\left[1+\frac{4x}{5}\right]^{\frac{-1}{2}}$

$$=5^{\frac{-1}{2}}\left[1+\left(\frac{-1}{2}\right)\left(\frac{4x}{5}\right)+\frac{\left(\frac{-1}{2}\right)\left(\frac{-1}{2}-1\right)}{2!}\left(\frac{4x}{5}\right)^2+\ldots\right]$$

$$=5^{\frac{-1}{2}}\left[1-\frac{2x}{5}+\frac{\left(\frac{-1}{2}\right)\left(\frac{-3}{2}\right)}{2}\times\frac{16x^2}{25}+\ldots\right]$$

$$=5^{\frac{-1}{2}}\left[1-\frac{2x}{5}+\frac{6x^2}{25}+\ldots.\right]$$

**Example – 36**

Find the coefficient of $x^4$ in the expansion of $\frac{1+x}{1-x}$ if $|x|<1$

**Sol.** $\frac{1+x}{1-x}=(1+x)(1-x)^{-1}$

$$=(1+x)\left[1+\frac{(-1)}{1!}(-x)\frac{(-1)(-1-1)}{2!}(-x)^2+\frac{(-1)(-1-1)(-1-2)}{3!}(-x)^3\ldots..\text{to}\,\infty\right]$$

$$=(1+x)(1+x+x^2+x^3+x^4+\ldots\ldots\text{ to }\infty)$$

$$=[1+x+x^2+x^3+x^4+\ldots\ldots.\text{ to }\infty]+[x+x^2+x^3+x^4+\ldots\ldots\ldots\text{ to }\infty]$$

$$=1+2x+2x^2+2x^3+2x^4+2x^5+\ldots\ldots\text{ to }\infty$$

Hence coefficient of $x^4=2$

**Example – 37**

Find the square root of 99 correct to 4 places of deicmal.

**Sol.** $(99)^{1/2}=(100-1)^{1/2}=\left[100\left(1-\frac{1}{100}\right)\right]^{\frac{1}{2}}$

$$=\left[100\left(1-\frac{1}{100}\right)\right]^{\frac{1}{2}}$$

$$=(100)^{1/2}[1-0.01]^{1/2}$$

$$=10\left[1+\frac{\frac{1}{2}}{1!}(-0.01)+\frac{\frac{1}{2}\left(\frac{1}{2}-1\right)}{2!}(-0.01)^2+\ldots\ldots..to\,\infty\right]$$

$$=10[1-0.005-0.0000125+\ldots\ldots\ldots\text{ to }\infty]$$

$$=10(.9949875)=9.94987=9.9499$$

**Example – 38**

The number of terms in the expansion of $(2x+3y-4z)^n$, is

(a) $n+1$ (b) $n+3$

(c) $\frac{(n+1)(n+2)}{2}$ (d) none of these

**Ans.** (c)

**Sol.** Number of terms $={}^{n+r-1}C_{r-1}$

$={}^{n+3-1}C_{3-1}$

$$=\frac{(n+2)(n+1)}{2}$$

**Example – 39**

The coefficient of $(a^3 b^6 c^8 d^9 e\ f)$ in the expansion of $(a + b + c - d - e - f)^{31}$ is :

(a) 123210 (b) 23110

(c) 3110 (d) none of these

**Ans.** (d)

**Sol.** The coefficient of $a^3 b^6 c^8 d^9 e\ f$ in expansion of $(a + b + c - d - e - f)^{31}$ is zero as that term is not possible in expansion as sum of powers in not 31.

**Example – 40**

Find the total number of terms in the expansion of $(1 + a + b)^{10}$ and coefficient of $a^2b^3$.

**Sol.** Total number of terms $= {}^{10+3-1}C_{3-1} = {}^{12}C_2 = 66$

Coefficient of $a^2b^3 = \dfrac{10!}{2!\times 3!\times 5!} = 2520$

# EXERCISE - 1 : BASIC OBJECTIVE QUESTIONS

### Binomial theorem for positive integral index

**1.** If $\frac{1}{\lfloor 8}+\frac{1}{\lfloor 9}=\frac{x}{\lfloor 10}$, then x is equal to

(a) 100 (b) 90

(c) 170 (d) none of these

**2.** The expansion $(x+a)^n={}^nC_0x^n+{}^nC_1x^{n-1}a^1+.....+{}^nC_na^n$ is valid when n is

(a) an integer (b) a natural number

(c) a rational number (d) none of these

**3.** $(x+\sqrt{x^3-1})^5+(x-\sqrt{x^3-1})^5$ is a polynomial of degree

(a) 5 (b) 6

(c) 7 (d) 8

**4.** $(1.003)^4$ is nearly equal to

(a) 1.012 (b) 1.0012

(c) 0.988 (d) 1.003

**5.** The number of non-zero terms in the expansion of

$$\left[\left(1+3\sqrt{2}\,x\right)^9+\left(1-3\sqrt{2}\,x\right)^9\right] \text{ is}$$

(a) 9 (b) 10

(c) 5 (d) None of these

### General term of binomial expansion

**6.** The term void of x in the expanion of $\left(x-\frac{3}{x^2}\right)^{18}$ is

(a) ${}^{18}C_6$ (b) ${}^{18}C_6 3^6$

(c) ${}^{18}C_{12}$ (d) ${}^{18}C_6 3^{12}$

**7.** If $n\in N$ and the coefficients of $x^{-7}$ and $x^{-8}$ to the expansion of $\left(2+\frac{1}{3x}\right)^n$ are equal then n =

(a) 56 (b) 15

(c) 45 (d) 55

**8.** If $n,p\in N$ and in the expansion of $(1+x)^n$ the coefficient of $p^{th}$ and $(p+1)^{th}$ terms are respectively p and q. The p + q =

(a) ${}^{n+3}C_p$ (b) ${}^{n+1}C_1$

(c) ${}^{n+2}C_1$ (d) ${}^nC_p$

**9.** 5th term from the end in the expansion of $\left(\frac{x^3}{2}-\frac{2}{x^2}\right)^{12}$ is

(a) $-7920\,x^{-4}$ (b) $7920\,x^4$

(c) $7920\,x^{-4}$ (d) $-7920\,x^4$

**10.** If the coefficients of (r + 4)th term and (2r + 1)th term in the expansion of $(1+x)^{18}$ are equal, then r =

(a) 3 (b) 5

(c) 3 or 5 (d) none of these

**11.** The term independent of x in the expansion of $\left(2x-\frac{3}{x^2}\right)^9$ is

(a) $3^3.{}^9C_3$ (b) $2^6.3^3\,{}^9C_3$

(c) $-3^3.{}^9C_3$ (d) $-2^6.3^3.{}^9C_3$

**12.** In the expansion of $\left(\frac{1}{2}x^{\frac{1}{3}}+x^{-\frac{1}{5}}\right)^8$, the term independent of x is

(a) $T_5$ (b) $T_7$

(c) $T_6$ (d) $T_8$

**13.** The term independent of x in the expansion of $\left[\left(t^{-1}-1\right)x+\left(t^{-1}+1\right)^{-1}x^{-1}\right]^8$ is :

(a) $56\left(\frac{1-t}{1+t}\right)^3$ (b) $56\left(\frac{1+t}{1-t}\right)^3$

(c) $70\left(\frac{1-t}{1+t}\right)^4$ (d) $70\left(\frac{1+t}{1-t}\right)^4$

**14.** The greatest value of the term independent of x, as α varies over R, in the expansion of $\left(x\cos\alpha+\frac{\sin\alpha}{x}\right)^{20}$ is :

(a) ${}^{20}C_{10}$ (b) ${}^{20}C_{19}$

(c) ${}^{20}C_6$ (d) ${}^{20}C_{10}\left(\frac{1}{2}\right)^{10}$

**15.** The coefficient of $x^8y^{10}$ in the expansion of $(x+y)^{18}$ is

(a) ${}^{18}C_8$ (b) ${}^{18}P_{10}$

(c) $2^{18}$ (d) None of these

16. If the term independent of x in the expansion of $\left(\sqrt{x}-\frac{\lambda}{x^2}\right)^{10}$ is 405, then λ equals

(a) –3 (b) 3

(c) 3 or –3 (d) None of these

17. If $(1+ax)^m = 1+8x+24x^2+...$, then the value of a and m are respectively.

(a) 4,2 (b) 2,4

(c) 1,8 (d) None of these

## Application of binomial theorem

18. If $n \in N$ then $49^n + 16n - 1$ is divisible by

(a) 3 (b) 19

(c) 64 (d) 29

19. Remainder when $7^{100}$ is divided by 25 is

(a) 1 (b) 24

(c) 18 (d) none of these

20. The co-efficient of $x^4$ in the expansion of $(1+x+x^2+x^3)^n$ is

(a) ${}^nC_4$ (b) ${}^nC_4 + {}^nC_2$

(c) ${}^nC_4 + {}^nC_1 + {}^nC_4 . {}^nC_2$ (d) ${}^nC_4 + {}^nC_2 + {}^nC_1 . {}^nC_2$

21. Co-efficient of $x^5$ in the expansion of $(x^2-x-2)^5$ is :

(a) –83 (b) –82

(c) –81 (d) 0

22. The number of integral terms in the expansion of $\left(\sqrt{3}+\sqrt{2}\right)^{500}$ is :

(a) 128 (b) 129

(c) 251 (d) 512

23. The coefficient of $x^{99}$ in $(x+1)(x+3)(x+5) ..... (x+199)$ is

(a) $1+2+3+....+99$ (b) $1+3+5+....+199$

(c) 1.3.5. ....... 199 (d) None of these

24. The coefficient of $x^{17}$ in the expansion of $(x-1)(x-2) ........ (x-18)$ is

(a) 342 (b) –171

(c) $\frac{171}{2}$ (d) 684

25. The coefficient of $x^{50}$ in the binomial expansion of $(1+x)^{1000} + x(1+x)^{999} + x^2(1+x)^{998} + ..... + x^{1000}$ is:

(a) $\frac{(1000)!}{(50)!(950)!}$ (b) $\frac{(1000)!}{(49)!(951)!}$

(c) $\frac{(1001)!}{(51)!(950)!}$ (d) $\frac{(1001)!}{(50)!(951)!}$

## Binomial coefficient problems

26. If ${}^nC_3 = {}^nC_2$, then n is equal to

(a) 2 (b) 3

(c) 5 (d) none of these

27. If ${}^{n+1}C_4 = 9\ {}^nC_2$ , then n =

(a) 10 (b) 9

(c) 12 (d) 11

28. If $n \in N$ and $(1+x)^n = 1 + a_1x + a_2x^2 + ... + a_nx^n$. If $a_1$, $a_2$ and $a_3$ are in A.P., then the value of *n* is

(a) 4 (b) 5

(c) 6 (d) 7

29. The sum ${}^rC_r + {}^{r+1}C_r + {}^{r+2}C_r + ... + {}^nC_r\ (n \geq r)$ equals

(a) ${}^nC_{r+1}$ (b) ${}^{n+1}C_{r+1}$

(c) ${}^{n+1}C_{r-1}$ (d) ${}^{n+1}C_r$

30. The sum of coefficient in the expansion of $(1+x-3x^2)^{3148}$ is

(a) 8 (b) 7

(c) 1 (d) –1

31. If the sum of the coefficients in the expansion of $(a^2x^2 - 6ax + 11)^{10}$, where a is constant, is 1024, then the value of a is :

(a) 5 (b) 1

(c) 2 (d) 3

32. If $n \in N$ and $(1-x+x^2)^n = a_0 + a_1x + a_2x^2 + ...... + a_{2n}x^{2n}$, then $a_0 + a_2 + a_4 + ... + a_{2n}$ is equal to :

(a) $\frac{3^n+1}{2}$ (b) $\frac{3^n-1}{2}$

(c) $3^n - \frac{1}{2}$ (d) $3^n + \frac{1}{2}$

33. The sum of the numerical coefficients in the expansion of

$\left(1+\frac{x}{3}+\frac{2y}{3}\right)^{12}$, is

(a) 1 (b) 2

(c) $2^{12}$ (d) none of these

34. In the expansion of $(1 + x)^{50}$, the sum of the coefficient of odd powers of x is

(a) 0 (b) $2^{49}$

(c) $2^{50}$ (d) $2^{51}$

35. Sum of the last 30 coefficients in the expansion of $(1 + x)^{59}$, when expanded in ascending powers of x is

(a) $2^{59}$ (b) $2^{58}$

(c) $2^{30}$ (d) $2^{29}$

36. ${}^{10}C_1 + {}^{10}C_2 + {}^{10}C_3 + \ldots\ldots\ldots\ldots + {}^{10}C_{10} =$

(a) 512 (b) 511

(c) 1024 (d) none of these

37. The value of ${}^{n}C_0 - {}^{n}C_1 + {}^{n}C_2 - \ldots. + (-1)^n\, {}^{n}C_n$ is

(a) 1 (b) n

(c) $2^n$ (d) 0

38. $\sum_{r=0}^{n} {}^{2n+1}C_{2r+1}$ is equal to

(a) $2^{2n}-1$ (b) $2^{2n}$

(c) $2^{2n+1}-1$ (d) $2^{2n+1}$

39. Let $S_1 = \sum_{j=1}^{10} j\,(j-1)\ {}^{10}C_j,\ S_2 = \sum_{j=1}^{10} j\ {}^{10}C_j$ and

$S_3 = \sum_{j=1}^{10} j^2\ {}^{10}C_j$

**Statement I :** $S_3 = 55\times2^9$.

**Statement II :** $S_1 = 90 \times 2^8$ and $S_2 = 10\times2^8$.

(a) Statement I is false, Statement II is true

(b) Statement I is true, Statement II is true;

Statement II is a correct explanation for Statement I

(c) Statement I is true, Statement II is true;

Statement II is not a correct explanation for Statement I

(d) Statement I is true, Statement II is false

40. **Statement I :** $\sum_{r=0}^{n}(r+1)\,.\ {}^{n}C_r = (n+2)\ 2^{n-1}$

**Statement II :** $\sum_{r=0}^{n}(r+1)\ {}^{n}C_r.x^r = (1+x)^n + nx\ (1+x)^{n-1}$

(a) Statement I is false, Statement II is true

(b) Statement I is true, Statement II is true;

Statement II is a correct explanation for Statement I

(c) Statement I is true, Statement II is true;

Statement II is not a correct explanation for Statement I

(d) Statement I is true, Statement II is false

41. a, b, c, d are any four consecutive co-efficients of any binomial expansion, then $\frac{a+b}{a}, \frac{b+c}{b}, \frac{c+d}{c}$ are in :

(a) A.P.

(b) G.P.

(c) H.P.

(d) arithmetico geometric progression

42. The value of

$\left({}^{7}C_0 + {}^{7}C_1\right)+\left({}^{7}C_1 + {}^{7}C_2\right)+\ldots+\left({}^{7}C_6 + {}^{7}C_7\right)$ is

(a) $2^7-1$ (b) $2^8-2$

(c) $2^8-1$ (d) $2^8$

### Numerical Value Type Questions

43. If $\underline{|n+2} = 210\,\underline{|n-1}$, then the value of n is equal to

44. The total number of terms in the expansion of $(x + a)^{100} + (x - a)^{100}$ after simplification is

45. If ${}^{2n}C_3 : {}^{n}C_2 : : 44 : 1$, then the value of n is

46. If ${}^{32}C_{2n-1} = {}^{32}C_{n-3}$, then n =

47. The coefficient of $x^3$ in $\left(\sqrt{x^5}+\frac{3}{\sqrt{x^3}}\right)^6$ is :

48. If the last term in the binomial expansion of $\left(2^{1/3}-\frac{1}{\sqrt{2}}\right)^n$ is $\left(\frac{1}{3^{5/3}}\right)^{\log_3 8}$, then the 5th term form the beginning is :

**49.** If rth term in the expansion of $\left(x^2+\frac{1}{x}\right)^{12}$ is independent of x, then r =

**50.** The middle term in the expansion of $\left(\frac{2x^2}{3}+\frac{3}{2x^2}\right)^{10}$ is

**51.** If $T_2/T_3$ in the expansion of $(a + b)^n$ and $T_3/T_4$ in the $(a + b)^{n+3}$ are equal, then n =

**52.** If $n \in N$ and second, third and fourth terms in the expansion of $(x + a)^n$ are 240, 720 and 1080 respectively, then the value of n is

**53.** If the sum of binomial coefficients in the expansion $\left(2x+\frac{1}{x}\right)^n$ is 256, then term independent of x is

**54.** Coefficient of $x^5$ in the expansion of $(1 + x^2)^5 (1 + x)^4$ is

**55.** The number of irrational terms in the expansion of $\left(4^{1/5}+7^{1/10}\right)^{45}$ is

# EXERCISE - 2 : PREVIOUS YEAR JEE MAIN QUESTIONS

**1.** If the number of terms in the expansion of $\left(1-\frac{2}{x}+\frac{4}{y}\right)^n$, $x \neq 0$, is 28, then the sum of the coefficients of all the terms in this expansion, is : **(2016)**

(a) 2187 (b) 243

(c) 729 (d) 64

**2.** For $x \in R$, $x \neq -1$, if

$$(1+x)^{2016}+x(1+x)^{2015}+x^2(1+x)^{2014}+\ldots\ldots+x^{2016}=\sum_{i=0}^{2016} a_i x^i,$$

then $a_{17}$ is equal to : **(2016/Online Set–1)**

(a) $\frac{2017!}{17!\,2000!}$ (b) $\frac{2016!}{17!\,1999!}$

(c) $\frac{2017!}{2000!}$ (d) $\frac{2016!}{16!}$

**3.** If the coefficients of $x^{-2}$ and $x^{-4}$ in the expansion of $\left(x^{\frac{1}{3}}+\frac{1}{2x^{\frac{1}{3}}}\right)^{18}$, $(x>0)$, are m and n respectively, then $\frac{m}{n}$ is equal to : **(2016/Online Set–2)**

(a) 182 (b) $\frac{4}{5}$

(c) $\frac{5}{4}$ (d) 27

**4.** The value of $\left({}^{21}C_1-{}^{10}C_1\right)+\left({}^{21}C_2-{}^{10}C_2\right)+\left({}^{21}C_3-{}^{10}C_3\right)+\left({}^{21}C_4-{}^{10}C_4\right)+\ldots..+\left({}^{21}C_{10}-{}^{10}C_{10}\right)$ is: **(2017)**

(a) $2^{21}-2^{11}$ (b) $2^{21}-2^{10}$

(c) $2^{20}-2^{9}$ (d) $2^{20}-2^{10}$

**5.** The coefficient of $x^{-5}$ in the binomial expansion of $\left(\frac{x+1}{x^{\frac{2}{3}}-x^{\frac{1}{3}}+1}-\frac{x-1}{x-x^{\frac{1}{2}}}\right)^{10}$, where $x \neq 0, 1$, is : **(2017/Online Set–2)**

(a) 1 (b) 4

(c) –4 (d) –1

**6.** The sum of the co-efficients of all odd degree terms in the expansion of $\left(x+\sqrt{x^3-1}\right)^5+\left(x-\sqrt{x^3-1}\right)^5$, $(x>1)$ is : **(2018)**

(a) 2 (b) -1

(c) 0 (d) 1

**7.** If n is the degree of the polynomial

$$\left[\frac{2}{\sqrt{5x^3+1}-\sqrt{5x^3-1}}\right]^8+\left[\frac{2}{\sqrt{5x^3+1}+\sqrt{5x^3-1}}\right]^8$$ and m is the coefficient of $x^n$ in it, then the ordered pair (n, m) is equal to : **(2018/Online Set–1)**

(a) $(24, (10)^8)$ (b) $(8, 5(10)^4)$

(c) $(12, (20)^4)$ (d) $(12, 8(10)^4)$

**8.** The coefficient of $x^{10}$ in the expansion of $(1+x)^2(1+x^2)^3(1+x^3)^4$ is equal to : **(2018/Online Set–2)**

(a) 52 (b) 56

(c) 50 (d) 44

**9.** The coefficient of $x^2$ in the expansion of the product $(2-x^2)\cdot((1+2x+3x^2)^6+(1-4x^2)^6)$ is : **(2018/Online Set–3)**

(a) 107 (b) 106

(c) 108 (d) 155

**10.** The sum of the series

$$2\cdot{}^{20}C_0+5\cdot{}^{20}C_1+8\cdot{}^{20}C_2+11\cdot{}^{20}C_3+\ldots+62\cdot{}^{20}C_{20}$$

is equal to: **(8-04-2019/Shift-1)**

(a) $2^{26}$ (b) $2^{25}$

(c) $2^{23}$ (d) $2^{24}$

**11.** The sum of the co-efficient of all even degree terms in x in the expansion of

$$\left(x+\sqrt{x^3-1}\right)^6+\left(x-\sqrt{x^3-1}\right)^6,(x>1) \text{ is equal to :}$$

**(8-04-2019/Shift-1)**

**12.** If the fourth term in the binomial expansion of $\left(\sqrt{x^{\frac{1}{1+\log_{10}x}}}+x^{\frac{1}{12}}\right)^6$ is equal to 200, and $x>1$, then the value of x is: **(8-04-2019/Shift-2)**

(a) 100 (b) 10

(c) $10^3$ (d) $10^4$

**13.** If the fourth term in the Binomial expansion of $\left(\frac{2}{x}+x^{\log_8 x}\right)^6 (x>0)$ is $20\times 8^7$, then a value of $x$ is :

**(9-04-2019/Shift-1)**

(a) $8^3$ (b) $8^{-2}$

(c) 8 (d) $8^2$

**14.** If some three consecutive coefficients in the binomial expansion of $(x+1)^n$ in powers of $x$ are in the ratio 2:15:70, then the average of these three coefficients is:

**(9-04-2019/Shift-2)**

(a) 964 (b) 232

(c) 227 (d) 625

**15.** If the coefficients of $x^2$ and $x^3$ are both zero, in the expansion of the expression $\left(1+ax+bx^2\right)(1-3x)^{15}$ in powers of $x$, then the ordered pair $(a, b)$ is equal to :

**(10-04-2019/Shift-1)**

(a) $(28, 861)$ (b) $(-54, 315)$

(c) $(28, 315)$ (d) $(-21, 714)$

**16.** The smallest natural number n, such that the coefficient of x in the expansion of $\left(x^2+\frac{1}{x^3}\right)^n$ is ${}^nC_{23}$, is:

**(10-4-2019/Shift-2)**

(a) 38 (b) 58

(c) 23 (d) 35

**17.** The coefficient of $x^{18}$ in the product $(1+x)(1-x)^{10}(1+x+x^2)^9$ is **(12-04-2019/Shift-1)**

**18.** If ${}^{20}C_1+\left(2^2\right){}^{20}C_2+\left(3^2\right){}^{20}C_3+...+\left(20^2\right){}^{20}C_{20}=A\left(2^{\beta}\right)$, then the ordered pair $(A, \beta)$ is equal to _____.

**(12-04-2019/Shift-2)**

(a) (420, 19) (b) (420, 18)

(c) (380, 18) (d) (380, 19)

**19.** The term independent of $x$ in the expansion of

$$\left(\frac{1}{60}-\frac{x^8}{81}\right)\cdot\left(2x^2-\frac{3}{x^2}\right)^6 \text{ is equal to ______.}$$

**(12-04-2019/Shift-2)**

(a) -72 (b) 36

(c) -36 (d) -108

**20.** If the fractional part of the number $\frac{2^{403}}{15}$ is $\frac{k}{15}$, then $k$ is equal to: **(9-01-2019/Shift-1)**

**21.** The coefficient of $t^4$ in the expansion of $\left(\frac{1-t^6}{1-t}\right)^3$

**(9-01-2019/Shift-2)**

(a) 14 (b) 15

(c) 10 (d) 12

**22.** If the third term in the binomial expansion of $\left(1+x^{\log_2 x}\right)^5$ equals 2560, then a possible value of $x$ is:

**(10-1-2019/Shift-1)**

(a) $\frac{1}{4}$ (b) $4\sqrt{2}$

(c) $\frac{1}{8}$ (d) $2\sqrt{2}$

**23.** If $\sum_{i=1}^{20}\left(\frac{{}^{20}C_{i-1}}{{}^{20}C_i+{}^{20}C_{i-1}}\right)^3=\frac{k}{21}$, then k equals:

**(10-1-2019/Shift-1)**

**24.** The positive value of $\lambda$ for which the co-efficient of $x^2$ in the expression $x^2\left(\sqrt{x}+\frac{\lambda}{x^2}\right)^{10}$ is 720, is:

**(10-01-2019/Shift-2)**

(a) 4 (b) $2\sqrt{2}$

(c) $\sqrt{5}$ (d) 3

**25.** If $\sum_{r=0}^{25}\left\{{}^{50}C_r \cdot {}^{50-r}C_{25-r}\right\} = K\left({}^{50}C_{25}\right)$, then K is equal to:

**(10-01-2019/Shift-2)**

(a) $(25)^2$ (b) $2^{25}-1$

(c) $2^{24}$ (d) $2^{25}$

**26.** The sum of the real values of $x$ for which the middle term in the binomial expansion of $\left(\frac{x^3}{3}+\frac{3}{x}\right)^8$ equals 5670 is,

**(11-01-2019/Shift-1)**

**27.** Let $(x+10)^{50}+(x-10)^{50} = a_0 + a_1x + a_2x^2 + \ldots.. + a_{50}x^{50}$, for all $x \in R$, then $\frac{a_2}{a_0}$ is equal to :

**(11-01-2019/Shift-2)**

(a) 12.50 (b) 12.00

(c) 12.25 (d) 12.75

**28.** Let $S_n = 1 + q + q^2 + \ldots\ldots. + q^n$ and

$T_n = 1+\left(\frac{q+1}{2}\right)+\left(\frac{q+1}{2}\right)^2+\ldots\ldots\ldots+\left(\frac{q+1}{2}\right)^n$ where q is a real number and $q \neq 1$.

If ${}^{101}C_1 + {}^{101}C_2.S_1 + \ldots\ldots.+{}^{101}C_{101}.S_{100} = \alpha T_{100}$, then $\alpha$ is equal to : **(11-01-2019/Shift-2)**

(a) $2^{99}$ (b) 202

(c) 200 (d) $2^{100}$

**29.** A ratio of the 5th term from the beginning to the 5th term from the end in the binomial expansion of $\left(2^{\frac{1}{3}}+\frac{1}{2(3)^{\frac{1}{3}}}\right)^{10}$ is **(12-01-2019/Shift-1)**

(a) $1:2(6)^{\frac{1}{3}}$ (b) $1:4(16)^{\frac{1}{3}}$

(c) $4(36)^{\frac{1}{3}}:1$ (d) $2(36)^{\frac{1}{3}}:1$

**30.** The total number of irrational terms in the binomial expansion of $\left(7^{\frac{1}{5}}-3^{\frac{1}{10}}\right)^{60}$ is **(12-01-2019/Shift-2)**

(a) 55 (b) 49

(c) 48 (d) 54

**31.** If ${}^nC_4$, ${}^nC_5$, and ${}^nC_6$ are in A.P., then $n$ can be:

**(12-01-2019/Shift-2)**

(a) 9 (b) 14

(c) 11 (d) 12

**32.** Let $\alpha > 0, \beta > 0$ be such that $\alpha^3+\beta^2=4$. If the maximum value of the term independent of $x$ in the binomial expansion of $\left(\alpha x^{\frac{1}{9}}+\beta x^{-\frac{1}{6}}\right)^{10}$ is 10k, then k is equal to :

**(2-9-2020/Shift-1)**

(a) 176 (b) 336

(c) 352 (d) 84

**33.** For a positive integer n, $\left(1+\frac{1}{x}\right)^n$ is expanded in increasing powers of x. If three consecutive coefficients in this expansion are in the ratio, 2:5:12, then n is equal to .........

**(2-09-2020/Shift-2)**

**34.** If the number of integral terms in the expansion of $\left(3^{\frac{1}{2}}+5^{\frac{1}{8}}\right)^n$ is exactly 33, then the least value of n is :

(3-09-2020/Shift-1)

(a) 128 (b) 248

(c) 256 (d) 264

**35.** If the term independent of x in the expansion of $\left(\frac{3}{2}x^2-\frac{1}{3x}\right)^9$ is k, then 18 k is equal to :

(3-09-2020/Shift-2)

(a) 5 (b) 9

(c) 7 (d) 11

**36.** Let $\left(2x^2+3x+4\right)^{10}=\sum_{r=0}^{20}a_r x^r$. Then $\frac{a_7}{a_{13}}$ is equal to ......

(4-09-2020/Shift-1)

**37.** If for some positive integer n, the coefficients of three consecutive terms in the binomial expansion of $(1+x)^{n+5}$ are in the ratio 5:10:14, then the largest coefficient in this expansion is : (4-9-2020/Shift-2)

(a) 792 (b) 252

(c) 462 (d) 330

**38.** The natural number m, for which the coefficient of x in the binomial expansion of $\left(x^m+\frac{1}{x^2}\right)^{22}$ is 1540, is ............... (5-09-2020/Shift-1)

**39.** The coefficient of $x^4$ in the expansion of $\left(1+x+x^2+x^3\right)^6$ in powers of $x$, is___ (5-09-2020/Shift-2)

**40.** If $\{p\}$ denotes the fractional part of the number p, then $\left\{\frac{3^{200}}{8}\right\}$, is equal to: (6-09-2020/Shift-1)

(a) $\frac{5}{8}$ (b) $\frac{1}{8}$

(c) $\frac{7}{8}$ (d) $\frac{3}{8}$

**41.** If the constant term in the binomial expansion of $\left(\sqrt{x}-\frac{k}{x^2}\right)^{10}$ is 405, then $|k|$ equals:

(6-09-2020/Shift-2)

(a) 1 (b) 9

(c) 2 (d) 3

**42.** If the sum of the coefficients of all even powers of $x$ in the product $\left(1+x+x^2+x^3.....+x^{2n}\right)$ $\left(1-x+x^2-x^3.....+x^{2n}\right)$ is 61, then $n$ is equal to

(7-01-2020/Shift-1)

**43.** The coefficient of $x^7$ in the expression $(1+x)^{10}+x(1+x)^9+x^2(1+x)^8+.......+x^{10}$ is :

(7-01-2020/Shift-2)

(a) 420 (b) 330

(c) 210 (d) 120

**44.** If $\alpha$ and $\beta$ be the coefficients of $x^4$ and $x^2$ respectively in the expansion of $\left(x+\sqrt{x^2-1}\right)^6+\left(x-\sqrt{x^2-1}\right)^6$, then

(8-01-2020/Shift-2)

(a) $\alpha+\beta=-30$ (b) $\alpha-\beta=-132$

(c) $\alpha+\beta=60$ (d) $\alpha-\beta=60$

**45.** The coefficient of $x^4$ in the expansion of $\left(1+x+x^2\right)^{10}$ is

(9-01-2020/Shift-1)

**46.** In the expansion of $\left(\frac{x}{\cos\theta}+\frac{1}{x\sin\theta}\right)^{16}$, if $l_1$ is the least value of the term independent of $x$ when $\frac{\pi}{8}\le\theta\le\frac{\pi}{4}$ and $l_2$ is the least value of the term independent of $x$ when $\frac{\pi}{16}\le\theta\le\frac{\pi}{8}$, then the ratio $l_2 : l_1$ is equal to :

(9-1-2020/Shift-2)

(a) 16 : 1 (b) 8 : 1

(c) 1 : 8 (d) 1 : 16

**47.** If $C_r = {}^{25}C_r$ and $C_0 + 5.\,C_1 + 9.\,C_2 + ... + 101.\,C_{25} = 2^{25}.\,k$ then k is equal to **(9-1-2020/Shift-2)**

**48.** The coefficient of $x^{256}$ in the expansion of $(1-x)^{101}(x^2+x+1)^{100}$ is: **(20-07-2021/Shift-1)**

(a) $-{}^{100}C_{16}$ (b) ${}^{100}C_{16}$

(c) ${}^{100}C_{15}$ (d) $-{}^{100}C_{15}$

**49.** The number of rational terms in the binomial expansion of $\left(4^{\frac{1}{4}}+5^{\frac{1}{6}}\right)^{120}$ is ______. **(20-07-2021/Shift-1)**

**50.** For the natural numbers m, n, if $(1-y)^m(1+y)^n = 1 + a_1y + a_2y^2 + ....... + a_{m+n}y^{m+n}$ and $a_1 = a_2 = 10$, then the value of $(m+n)$ is equal to **(20-07-2021/Shift-2)**

(a) 88 (b) 64

(c) 100 (d) 80

**51.** If b is very small as compared to the value of a, so that the cube and other higher powers of $\frac{b}{a}$ can be neglected in the identity

$$\frac{1}{a-b}+\frac{1}{a-2b}+\frac{1}{a-3b}.........+\frac{1}{a-nb}=\alpha n+\beta n^2+\gamma n^3,$$

then the value of $\gamma$ is is ? **(25-07-2021/Shift-1)**

(a) $\frac{b^2}{3a^3}$ (b) $\frac{a+b}{3a^2}$

(c) $\frac{a^2+b}{3a^3}$ (d) $\frac{a+b^2}{3a^3}$

**52.** The term independent of 'x' in the expansion of $\left(\frac{x+1}{x^{2/3}-x^{1/3}+1}-\frac{x-1}{x-x^{1/2}}\right)^{10}$, where $x \neq 0, 1$ is equal to __________ ? **(25-07-2021/Shift-1)**

**53.** The ratio of the coefficient of the middle term in the expansion of $(1+x)^{20}$ and the sum of the coefficients of two middle terms in expansion of $(1+x)^{19}$ is ? **(25-07-2021/Shift-1)**

**54.** The probability that a randomly selected 2 digit number belongs to the set $\left(n \in N : (2^n - 2)\right.$ is a multiple of $\left.3\right)$ is equal to : **(27-07-2021/Shift-1)**

(a) $\frac{1}{2}$ (b) $\frac{1}{3}$

(c) $\frac{2}{3}$ (d) $\frac{1}{6}$

**55.** If the coefficients of $x^7$ in $\left(x^2+\frac{1}{bx}\right)^{11}$ and $x^{-7}$ in $\left(x-\frac{1}{bx^2}\right)^{11}$, $b \neq 0$, are equal, then the value of b is equal to: **(27-07-2021/Shift-1)**

(a) –1 (b) 2

(c) –2 (d) 1

**56.** A possible value of 'x', for which the ninth term in the expansion of $\left\{3^{\log_3\sqrt{25^{x-1}+7}}+3^{\left(-\frac{1}{8}\right)\log_3\left(5^{x-1}+1\right)}\right\}^{10}$ in the increasing powers of $3^{\left(\frac{1}{8}\right)\log_3\left(5^{x-1}+1\right)}$ is equal to 180, is: **(27-07-2021/Shift-2)**

(a) 2 (b) 1

(c) 0 (d) –1

**57.** The number of elements in the set $\left\{n \in \{1, 2, 3, ....., 100\} \,\middle|\, (11)^n > (10)^n + (9)^n\right\}$ is ______. is **(22-07-2021/Shift-2)**

**58.** If the constant term, in binomial expansion of $\left(2x^r+\frac{1}{x^2}\right)^{10}$ is 180, then r is equal to _____. **(22-07-2021/Shift-2)**

**59.** The sum of all those terms which are rational numbers in the expansion of $\left(2^{\frac{1}{3}}+3^{\frac{1}{4}}\right)^{12}$ is: **(25-07-2021/Shift-2)**

(a) 27 (b) 89

(c) 35 (d) 43

**60.** If the greatest value of the term independent of 'x' in the expansion of $\left(x\sin\alpha + a\frac{\cos\alpha}{x}\right)^{10}$ is $\frac{10!}{(5!)^2}$, then the value of 'a' is equal to: **(25-07-2021/Shift-2)**

(a) 2 (b) –1

(c) 1 (d) –2

**61.** The lowest integer which is greater than $\left(1+\frac{1}{10^{100}}\right)^{10^{100}}$ is ______. **(25-07-2021/Shift-2)**

(a) 3 (b) 4

(c) 2 (d) 1

**62.** If the coefficients of $x^7$ and $x^8$ in the expansion of $\left(2+\frac{x}{3}\right)^n$ are equal, then the value of n is equal to___. **(25-07-2021/Shift-2)**

**63.** Let $n \in N$ and $[x]$ denote the greatest integer less than or equal to x. If the sum of $(n+1)$ terms of ${}^nC_0, 3.{}^nC_1, 5.{}^nC_2, 7.{}^nC_3, \ldots$..is equal to $2^{100}.101$, then $2\left[\frac{n-1}{2}\right]$ is equal to________. **(25-07-2021/Shift-2)**

**64.** If the sum of the coefficients in the expansion of $(x+y)^n$ is 4096, than greatest coefficient in the expansion is_______ ? **(01-09-2021/Shift-2)**

**65.** Let $\binom{n}{k}$ denote ${}^nC_k$ and $\left[\begin{matrix} n \\ k \end{matrix}\right] = \begin{cases} \binom{n}{k}, & \text{if } 0 \le k \le n \\ 0 & \text{, otherwise} \end{cases}$

If $A_k = \sum_{i=0}^{9}\binom{9}{i}\left[\begin{matrix} 12 \\ 12-k+i \end{matrix}\right] + \sum_{i=0}^{8}\binom{8}{i}\left[\begin{matrix} 13 \\ 13-k+i \end{matrix}\right]$ and $A_4 - A_3 = 190p$, then p is equal to _______. **(26-08-2021/Shift-2)**

**66.** $\sum_{k=0}^{20}\left({}^{20}C_k\right)^2$ is equal to: **(27-08-2021/Shift-1)**

(a) ${}^{41}C_{20}$ (b) ${}^{40}C_{20}$

(c) ${}^{40}C_{21}$ (d) ${}^{40}C_{19}$

**67.** If ${}^{20}C_r$ is the co-efficient of $x^r$ in the expansion of $(1+x)^{20}$, then the value of $\sum_{r=0}^{20} r^2\, {}^{20}C_r$ is equal to : **(26-08-2021/Shift-1)**

(a) $420\times 2^{19}$ (b) $420\times 2^{18}$

(c) $380\times 2^{18}$ (d) $380\times 2^{19}$

**68.** $3\times 7^{22} + 2\times 10^{22} - 44$ when divided by 18 leaves the remainder ___________. **(27-08-2021/Shift-2)**

**69.** If $\left(\frac{3^6}{4^4}\right)k$ is the term independent of $x$ in the binomial expansion of $\left(\frac{x}{4}-\frac{12}{x^2}\right)^{12}$, then $k$ is equal to __________ ? **(31-08-2021/Shift-1)**

**70.** If the coefficient of $a^7b^8$ in the expansion of $(a+2b+4ab)^{10}$ is $K\cdot 2^{16}$, then $K$ is equal to______. **(31-08-2021/Shift-2)**

**71.** Let n be a positive integer. Let

$$A = \sum_{k=0}^{n}(-1)^k\, {}^nC_k\left[\left(\frac{1}{2}\right)^k + \left(\frac{3}{4}\right)^k + \left(\frac{7}{8}\right)^k + \left(\frac{15}{16}\right)^k + \left(\frac{31}{32}\right)^k\right]$$

If $63A = 1-\frac{1}{2^{30}}$, then n is equal to ____. **(16-03-2021/Shift-2)**

**72.** If $n$ is the number of irrational terms in the expansion of $\left(3^{\frac{1}{4}}+5^{\frac{1}{8}}\right)^{60}$, then $(n-1)$ is divisible by **(16-03-2021/Shift-1)**

(a) 8 (b) 26

(c) 7 (d) 30

**73.** The value of $\sum_{r=0}^{6}\left({}^6C_r \cdot {}^6C_{6-r}\right)$ is equal to : **(17-03-2021/Shift-2)**

(a) 1024 (b) 1124

(c) 1324 (d) 924

**74.** Let the coefficients of third, fourth and fifth terms in the expansion of $\left(x+\frac{a}{x^2}\right)^n$, $x \neq 0$, be in the ratio 12 : 8 : 3. Then the term independent of $x$ in the expansion, is equal to ............ .

(Round off the answer to nearest integer)

**(17-03-2021/Shift-2)**

**75.** If $(2021)^{3762}$ is divided by 17, then the remainder is ……………..

**(17-03-2021/Shift-1)**

**76.** The term independent of x in the expansion of

$$\left[\frac{x+1}{x^{2/3}-x^{1/3}+1}-\frac{x-1}{x-x^{1/2}}\right]^{10}, \quad x \neq 1, \text{ is equal to}$$

_______.

**(18-03-2021/Shift-2)**

**77.** Let ${}^nC_r$ denote the binomial coefficient of $x^r$ in the expansion of $(1+x)^n$. If

$$\sum_{k=0}^{10}(2^2+3k)\,{}^nC_k = \alpha.3^{10}+\beta.2^{10},\ \alpha,\beta\in R, \text{ then } \alpha+\beta$$

is equal to _______.

**(18-03-2021/Shift-2)**

**78.** Let $(1+x+2x^2)^{20} = a_0 + a_1x + a_2x^2 + ......+ a_{40}x^{40}$.

Then, $a_1 + a_3 + a_5 + .....+ a_{37}$ is equal to :

**(18-03-2021/Shift-1)**

(a) $2^{20}\ (2^{20}-21)$ (b) $2^{19}\ (2^{20}+21)$

(c) $2^{19}\ (2^{20}-21)$ (d) $2^{20}\ (2^{20}+21)$

**79.** If $n \geq 2$ is a positive integer, then the sum of the series

$${}^{n+1}C_2 + 2\left({}^2C_2 + {}^3C_2 + {}^4C_2 + ....+ {}^nC_2\right) \text{ is}$$

**(24-02-2021/Shift-2)**

(a) $\frac{n(n+1)^2(n+2)}{12}$ (b) $\frac{n(n+1)(2n+1)}{6}$

(c) $\frac{n(n-1)(2n+1)}{6}$ (d) $\frac{n(2n+1)(3n+1)}{6}$

**80.** For integers n and r, let $\binom{n}{r} = \begin{cases} {}^nC_r, & \text{if } n \geq r \geq 0 \\ 0, & \text{otherwise} \end{cases}$

The maximum value of k for which the sum

$$\sum_{i=0}^{k}\binom{10}{i}\binom{15}{k-i}+\sum_{i=0}^{k+1}\binom{12}{i}\binom{13}{k+1-i} \text{ is maximum, is}$$

equal to ____.

**(24-02-2021/Shift-2)**

**81.** The value of

$$-{}^{15}C_1 + 2\,{}^{15}C_2 - 3\,{}^{15}C_3 + \cdots - 15\,{}^{15}C_{15}$$

$$+\,{}^{14}C_1 + {}^{14}C_3 + {}^{14}C_5 + \cdots + {}^{14}C_{11}$$

**(24-02-2021/Shift-1)**

(a) $2^{14}$ (b) $2^{13}-13$

(c) $2^{16}$ (d) $2^{13}-14$

**82.** If the reminder when $x$ is divided by 4 is 3, then the remainder when $(2020+x)^{2022}$ is divided by 8 is_______.

**(25-02-2021/Shift-2)**

**83.** The maximum value of the term independent of 't' in the expansion of $\left(tx^{\frac{1}{5}}+\frac{(1-x)^{\frac{1}{10}}}{t}\right)^{10}$ where $x \in (0,1)$ is

**(26-02-2021/Shift-1)**

(a) $\frac{10!}{3(5!)^2}$ (b) $\frac{2.10!}{3\sqrt{3}(5!)^2}$

(c) $\frac{10!}{\sqrt{3}(5!)^2}$ (d) $\frac{2.10!}{3(5!)^2}$

**84.** Let $m, n \in N$ and $\gcd(2,n)=1$. If

$$30\binom{30}{0}+29\binom{30}{1}+.....+2\binom{30}{28}+1\binom{30}{29}=n\cdot 2^m, \text{ then}$$

$n+m$ is equal to _____. $\left(\text{Here } \binom{n}{k} = {}^nC_k\right)$

**(26-02-2021/Shift-1)**

**85.** If the fourth term in the expansion of $(x+x^{\log_2 x})^7$ is 4480, then the value of $x$ where $x \in N$ is equal to :

**(17-03-2021/Shift-1)**

(a) 4 (b) 2

(c) 3 (d) 1

# EXERCISE - 3 : ADVANCED OBJECTIVE QUESTIONS

## Objective Questions I [Only one correct option]

**1.** The ratio of the coefficient of $x^{10}$ in $(1-x^2)^{10}$ and the term independent of x in $\left(x-\frac{2}{x}\right)^{10}$, is

(a) 1 : 16  (b) 1 : 32
(c) 1 : 64  (d) none of these

**2.** If the fourth term in the expansion of $\left(px+\frac{1}{x}\right)^n$ is independent of x, then the value of term is

(a) $5p^3$  (b) $10p^3$
(c) $20p^3$  (d) none of these

**3.** The greatest coefficent in the expansion of $(1 + x)^{2n}$ is

(a) ${}^{2n}C_n$  (b) ${}^{2n}C_{n-1}$
(c) ${}^{2n}C_{n-2}$  (d) none of these

**4.** Which of the following expression is divisible by 1225 ?

(a) $6^{2n} - 35n - 1$  (b) $6^{2n} - 35n + 1$
(c) $6^{2n} - 35n$  (d) $6^{2n} - 35n + 2$

**5.** The number of distinct terms in the expansion of $(x + y - z)^{16}$ is

(a) 136  (b) 153
(c) 16  (d) 17

**6.** The total number of terms in the expansion of $(a + b + c + d)^n$, $n \in N$ is

(a) $\frac{n(n+1)(n+2)}{6}$  (b) $\frac{n(n+1)(n+2)(n+3)}{6}$

(c) $\frac{(n+1)(n+2)(n+3)}{6}$  (d) none of these

**7.** If rth and (r + 1)th term in the expansion of $(1 + x)^n$ are equal, then n =

(a) $\frac{(1+x)r-x}{4x}$  (b) $\frac{(1+x)r-x}{3x}$

(c) $\frac{(1+x)r-x}{x}$  (d) $\frac{(1+x)r-x}{r}$

**8.** In the binomial expansion of $(a - b)^n$, $n \ge 5$, the sum of the $5^{th}$ and $6^{th}$ terms is zero. Then, a/b equals

(a) $\frac{n-5}{6}$  (b) $\frac{n-4}{5}$

(c) $\frac{5}{n-4}$  (d) $\frac{6}{n-5}$

**9.** The greatest value of the term independent of x in the expansion of $(x \sin\alpha + x^{-1}\cos\alpha)^{10}$, $\alpha \in R$, is

(a) $2^5$  (b) $\frac{10!}{(5!)^2}$

(c) $\frac{10!}{2^5 \times (5!)^2}$  (d) none of these

**10.** If the ratio of 7th term from the beginning to the seventh term from the end in the expansion of $\left(\sqrt[3]{2}+\frac{1}{\sqrt[3]{3}}\right)^x$ is $\frac{1}{6}$ then x, is

(a) 9  (b) 6, 15
(c) 12, 9  (d) none of these

**11.** The sum of coefficients of the two middle terms in the expansions of $(1 + x)^{2n-1}$ is equal to :

(a) ${}^{(2n-1)}C_n$  (b) ${}^{(2n-1)}C_{n+1}$
(c) ${}^{2n}C_{n-1}$  (d) ${}^{2n}C_n$

**12.** The greatest term (numerically) in the expansion of $(2 + 3x)^9$, when $x = \frac{3}{2}$, is

(a) $\frac{5\times3^{11}}{2}$  (b) $\frac{5\times3^{13}}{2}$

(c) $\frac{7\times3^{13}}{2}$  (d) none of these

**13.** The greatest term (numerically) in the expansion of $(3 - 5x)^{11}$, when $x = \frac{1}{5}$ is

(a) $55 \times 3^9$  (b) $46 \times 3^9$
(c) $55 \times 3^6$  (d) none of these

**14.** If $7^{103}$ is divided by 25, then the remainder is
(a) 20 (b) 16
(c) 18 (d) 15

**15.** The last digit of the number $(32)^{32}$ is
(a) 4 (b) 6
(c) 8 (d) none of these

**16.** $9^7 + 7^9$ is divisible by
(a) 6 (b) 24
(c) 64 (d) 72

**17.** The number $5^{25} - 3^{25}$ is divisible by :
(a) 2 (b) 3
(c) 5 (d) 7

**18.** If $0 \le r \le n$, then the coefficient of $x^r$ in the expansion of $P = 1 + (1 + x) + (1 + x)^2 + ..... + (1 + x)^n$ is
(a) ${}^nC_r$ (b) ${}^{n+1}C_{r+1}$
(c) ${}^nC_{r+1}$ (d) none of these

**19.** The coefficient of $x^{20}$ in the expansion of $(1+x^2)^{40}.\left(x^2+2+\frac{1}{x^2}\right)^{-5}$ is
(a) ${}^{30}C_{10}$ (b) ${}^{30}C_{25}$
(c) 1 (d) none of these

**20.** The integral part of $(\sqrt{2}+1)^6$ is:
(a) 198 (b) 197
(c) 196 (d) 163

**21.** If $\frac{1}{1-2x+x^2} = 1 + a_1x + a_2x^2 + ...$, then the value of $a_r$ is
(a) 2r (b) r + 1
(c) r (d) r – 1

**22.** The value of ${}^{50}C_4 + \sum_{r=1}^{6} {}^{56-r}C_3$ is
(a) ${}^{56}C_4$ (b) ${}^{56}C_3$
(c) ${}^{55}C_3$ (d) ${}^{55}C_4$

**23.** If n is a positive integer greater than 1, then $a - {}^nC_1(a-1) + {}^nC_2(a-2) - .... + (-1)^n(a-n)$ is equal to
(a) n (b) a
(c) 0 (d) none of these

**24.** If $(1 + x)^{15} = C_0 + C_1x + C_2x^2 + .... + C_{15}x^{15}$, then ${}^{15}C_0^2 - {}^{15}C_1^2 + {}^{15}C_2^2 - {}^{15}C_3^2 + .... {}^{15}C_{15}^2$ is equal to
(a) 0 (b) 1
(c) –1 (d) none of these

**25.** The sum $1.\,{}^{20}C_1 - 2.\,{}^{20}C_2 + 3.\,{}^{20}C_3 - ..... - {}^{20}C_{20}$ is equal to
(a) $2^{19}$ (b) 0
(c) $2^{20} - 1$ (d) none of these

**26.** $1.\,{}^nC_1 + 2,\,{}^nC_2 + 3.\,{}^nC_3 + .... + n.\,{}^nC_n$ is equal to
(a) $\frac{n(n+1)}{4}.2^n$ (b) $2^{n+1}-3$
(c) $n2^{n-1}$ (d) none of these

**27.** If $C_r$ stands for ${}^nC_r$, then the sum of the series
$$\frac{2\left(\frac{n}{2}\right)!\left(\frac{n}{2}\right)!}{n!}\left[C_0^2 - 2C_1^2 + 3C_2^2 - .... + (-1)^n(n+1)C_n^2\right]$$
where n is an even positive integer, is equal to :
(a) $(-1)^{n/2}(n+2)$ (b) $(-1)^n(n+1)$
(c) $(-1)^{n/2}(n+1)$ (d) none of these

**28.** If $A = {}^{2n}C_0.\,{}^{2n}C_1 + {}^{2n}C_1\,{}^{2n-1}C_1 + {}^{2n}C_2\,{}^{2n-2}C_1 + .....$then A is
(a) 0 (b) $2^n$
(c) $n2^{2n}$ (d) 1

**29.** The coefficient of $x^{50}$ in the expansion : $(1 + x)^{1000} + 2x(1 + x)^{999} + 3x^2(1 + x)^{998} + ...+1001$ terms
(a) ${}^{1002}C_{50}$ (b) ${}^{1002}C_{51}$
(c) ${}^{1005}C_{50}$ (d) ${}^{1005}C_{48}$

**30.** If $s_n = \sum_{r=0}^{n} \frac{1}{{}^nC_r}$ and $t_n = \sum_{r=0}^{n} \frac{r}{{}^nC_r}$ then $\frac{t_n}{s_n}$ is equal to
(a) $\frac{n}{2}$ (b) $\frac{n}{2}-1$
(c) $n - 1$ (d) $\frac{2n-1}{2}$

**31.** If 7 divides $32^{32^{32}}$, the remainder is :
(a) 1 (b) 0
(c) 4 (d) 6

**32.** The term independent of x in the expansion of $(1 + x)^n \left(1+\frac{1}{x}\right)^n$ is :
(a) $C_0^2 + 2C_1^2 + 3C_2^2 + ... + (n+1)C_n^2$
(b) $(C_0 + C_1 + C_2 + ... + C_n)^2$
(c) $C_0^2 + C_1^2 + ... + C_n^2$
(d) none of these

33. The number of terms in the expansion of $\left(x^2+1+\frac{1}{x^2}\right)^n$, $n \in N$ is.

(a) 2n (b) 3n

(c) 2n + 1 (d) 3n + 1

34. Integral part of $(7+4\sqrt{3})^n$ is $(n \in N)$

(a) an even number

(b) an odd number

(c) an even or an odd number depending upon the of n

(d) none of these

## Objective Questions II [One or more than one correct option]

35. In the expansion of $(x+y+z)^{25}$

(a) every term is of the form ${}^{25}C_r \cdot {}^rC_k \cdot x^{25-r} \cdot y^{r-5} \cdot z^k$

(b) the coefficient of $x^8y^9z^9$ is 0

(c) the number of term is 325

(d) none of these.

36. Element in set of values of r for which,

${}^{18}C_{r-2}+2.\ {}^{18}C_{r-1}+{}^{18}C_r \geq {}^{20}C_{13}$ is :

(a) 9 (b) 5

(c) 7 (d) 10

37. The expansion of $(3x+2)^{-1/2}$ is valid in ascending powers of x, if x lies in the interval

(a) (0, 2/3) (b) (-3/2, 3/2)

(c) (-2/3, 2/3) (d) $(-\infty, -3/2)\ (3/2, \infty)$

## Numerical Value Type Questions

38. If ${}^nC_{r-1}=36$, ${}^nC_r=84$ and ${}^nC_{r+1}=126$, then r =

39. Let the co-efficients of $x^n$ in $(1+x)^{2n}$ & $(1+x)^{2n-1}$ be P & Q respectively, then $\left(\frac{P+Q}{P}\right)^4=$

40. Sum of square of all possible values of 'r' satisfying the equation

${}^{39}C_{3r-1}-{}^{39}C_{r^2}={}^{39}C_{r^2-1}-{}^{39}C_{3r}$ is :

41. If $\frac{1}{1!10!}+\frac{1}{2!9!}+\frac{1}{3!8!}+......+\frac{1}{10!1!}=\frac{(2^{10}-1)}{k10!}$ then find the value of k.

42. The coefficient of $x^{99}$ in the polynomial $(x-1)(x-2)....(x-100)$ is .....

## Match the Following

**Each question has two columns. Four options are given representing matching of elements from Column-I and Column-II. Only one of these four options corresponds to a correct matching.For each question, choose the option corresponding to the correct matching.**

43. Match the entries in Column-I representing in n with their values given in Column-II.

| Column I | Column II |
|---|---|
| **(A)** ${}^{16}C_n+{}^{16}C_{n+1}+{}^{17}C_{n+2} \geq {}^{18}C_{2n-1}$ | **(P)** 15 |
| **(B)** ${}^{16}C_{n+5} \leq {}^{17}C_{n+6}$ | **(Q)** 6 |
| **(C)** $12\times({}^nC_6)^2 \leq 7\times({}^{n+1}C_5)\times({}^{n+1}C_7)$ | **(R)** 7 |
| **(D)** $2\times({}^{n-1}C_4-{}^{n-1}C_3) < 5\times({}^{n-2}C_2)$ | **(S)** 12 |

**The correct matching is**

(a) A–Q, R ; B–Q, R ; C–P, Q, R, S; D–Q, R

(b) A–Q ; B–Q, R ; C–P, Q, R, S; D–Q, R

(c) A–Q, R ; B–Q ; C–P, Q, R, S; D–Q, R

(d) A–Q, R ; B–Q, R ; C–P, Q, S; D–Q, R

44. Match the following with their no. of terms.

| Column-I | Column-II |
|---|---|
| **(A)** $(x_1+x_2+x_3......+x_n)^3$ | **(P)** infinite |
| **(B)** $(x_1+x_2+x_3)^n$ | **(Q)** ${}^{n+2}C_3$ |
| **(C)** $(1-x)^{-3}\ (\lvert x \rvert<1)$ | **(R)** $\leq 2n+1$ |
| **(D)** $(1+x+x^2)^n$ | **(S)** ${}^{n+2}C_2$ |

**The correct matching is**

(a) A– Q; B–S; C–R; D–Q

(b) A –S; B–S; C–P; D–R

(c ) A –Q; B –S; C–R; D–R

(d) A –Q; B –S; C–P; D–R

Text

**45.** Let n be a positive integer and $(1+x+x^2)^n = a_0 + a_1x + ..... + a_{2n}x^{2n}$.

Show that $a_0^2 - a_1^2 + ..... + a_{2n}^2 = a_n$.

**46.** Given $s_n = 1 + q + q^2 + ..... + q^n$

$$S_n = 1 + \frac{q+1}{2} + \left(\frac{q+1}{2}\right)^2 + .... + \left(\frac{q+1}{2}\right)^n, q \neq 1.$$

Prove that ${}^{n+1}C_1 + {}^{n+1}C_2 s_1 + {}^{n+1}C_3 s_2 + .... + {}^{n+1}C_{n+1} s_n = 2^n S_n$

**47.** Find the sum of the series :

$$\sum_{r=0}^{n} (-1)^r \, {}^nC_r \left[\frac{1}{2^r} + \frac{3^r}{2^{2r}} + \frac{7^r}{2^{3r}} + \frac{15^r}{2^{4r}} \text{....upto m terms}\right]$$

**48.** Prove that $C_0 - 2^2 . C_1 + 3^2 . C_2 - ..... + (-1)^n (n+1)^2 . C_n = 0$, $n > 2$ where $C_r = {}^nC_r$.

**49.** Prove that : $({}^{2n}C_0)^2 - ({}^{2n}C_1)^2 + ({}^{2n}C_2)^2 + ... + ({}^{2n}C_{2n})^2 = (-1)^n . {}^{2n}C_n$.

**50.** Prove that :

$$C_1^2 - 2.C_2^2 + 3.C_3^2 - ...... - 2n.C_{2n}^2 = (-1)^n n . {}^{2n}C_n$$

# EXERCISE - 4 : PREVIOUS YEAR JEE ADVANCED QUESTIONS

### Objective Questions I [Only one correct option]

**1.** For $2 \le r \le n$, $\binom{n}{r}+2\binom{n}{r-1}+\binom{n}{r-2}$ is equal to : **(2000)**

(a) $\binom{n+1}{r-1}$ (b) $2\binom{n+1}{r-1}$

(c) $2\binom{n+2}{r}$ (d) $\binom{n+2}{r}$

**2.** In the binomial expansion of $(a-b)^n$, $n \ge 5$ the sum of the $5^{th}$ and $6^{th}$ terms is zero. Then a/b equals : **(2001)**

(a) $\frac{n-5}{6}$ (b) $\frac{n-4}{5}$

(c) $\frac{5}{n-4}$ (d) $\frac{6}{n-5}$

**3.** The sum $\sum_{i=0}^{m}\binom{10}{i}\binom{20}{m-i}$, where $\binom{p}{q}=0$ if $p>q$, is maximum when m is : **(2002)**

(a) 5 (b) 10

(c) 15 (d) 20

**4.** Coefficient of $t^{24}$ in $(1+t^2)^{12}(1+t^{12})(1+t^{24})$ is : **(2003)**

(a) ${}^{12}C_6+3$ (b) ${}^{12}C_6+1$

(c) ${}^{12}C_6$ (d) ${}^{12}C_6+2$

**5.** If ${}^{n-1}C_r = (k^2-3)\,{}^{n}C_{r+1}$, then k belong to : **(2004)**

(a) $(-\infty, -2]$ (b) $[2, \infty)$

(c) $[-\sqrt{3}, \sqrt{3}]$ (d) $(\sqrt{3}, 2]$

**6.** $\binom{30}{0}\binom{30}{10}-\binom{30}{1}\binom{30}{11}+....+\binom{30}{20}\binom{30}{30}$ is equal to **(2005)**

(a) ${}^{30}C_{11}$ (b) ${}^{60}C_{10}$

(c) ${}^{30}C_{10}$ (d) ${}^{65}C_{55}$

**7.** For r = 0, 1, ...., 10, let $A_r$, $B_r$ and $C_r$ denote, respectively, the coefficient of $x^r$ in the expansions of $(1+x)^{10}$, $(1+x)^{20}$ and $(1+x)^{30}$. Then $\sum_{r=1}^{10} A_r\,(B_{10}B_r - C_{10}A_r)$ is equal to **(2010)**

(a) $B_{10}-C_{10}$ (b) $A_{10}\left(B_{10}^2-C_{10}A_{10}\right)$

(c) 0 (d) $C_{10}-B_{10}$

**8.** Coefficient of $x^{11}$ in the expansion of $(1+x^2)^4(1+x^3)^7(1+x^4)^{12}$ is **(2014)**

(a) 1051 (b) 1106

(c) 1113 (d) 1120

### Numerical Value Type Questions

**9.** The coefficient of three consecutive terms $(1+x)^{n+5}$ are in the ratio 5 : 10 : 14. Then, n is equal to **(2013)**

**10.** The coefficient of $x^9$ in the expansion of $(1+x)(1+x^2)(1+x^3)\ldots(1+x^{100})$ is **(2015)**

**11.** Let m be the smallest positive integer such that the coefficient of $x^2$ in the expansion of $(1+x)^2+(1+x)^3+.....+(1+x)^{49}+(1+mx)^{50}$ is $(3n+1)\,{}^{51}C_3$ for some positive integer n. Then the value of n is **(2016)**

**12.** Let $X=({}^{10}C_1)^2+2({}^{10}C_2)^2+3({}^{10}C_3)^2+.....+10({}^{10}C_{10})^2$, where ${}^{10}C_r$, $r \in \{1, 2, ..., 10\}$ denote binomial coefficients. Then, the value of $\frac{1}{1430}X$ is ______ **(2018)**

**13.** Suppose $\det\begin{bmatrix} \sum_{k=0}^{n} k & \sum_{k=0}^{n} {}^nC_k k^2 \\ \sum_{k=0}^{n} {}^nC_k k & \sum_{k=0}^{n} {}^nC_k 3^k \end{bmatrix}=0$ holds for some positive integer n. Then $\sum_{k=0}^{n}\frac{{}^nC_k}{k+1}$ equals. **(2019)**

Text

**14.** For any positive integers m, n (with $n \geq m$),

let $\binom{n}{m} = {}^{n}C_{m}$. Prove that

$$\binom{n}{m}+\binom{n-1}{m}+\binom{n-2}{m}+\ldots+\binom{m}{m}=\binom{n+1}{m+1}$$

Hence, or otherwise, prove that

$$\binom{n}{m}+2\binom{n-1}{m}+3\binom{n-2}{m}+\ldots.+(n-m+1)\binom{m}{m}=\binom{n+2}{m+2}$$

**(2000)**

**15.** Prove that

$$2^{k}\binom{n}{0}\binom{n}{k}-2^{k-1}\binom{n}{1}\binom{n-1}{k-1}+2^{k-2}\binom{n}{2}\binom{n-2}{k-2}-\ldots..$$

$$+(-1)^{k}\binom{n}{k}\binom{n-k}{0}=\binom{n}{k}$$

**(2003)**

# Answer Key

## CHAPTER -12 | BINOMIAL THEOREM

### EXERCISE - 1 : BASIC OBJECTIVE QUESTIONS

| | | | | |
|---|---|---|---|---|
| **1.** (a) | **2.** (b) | **3.** (c) | **4.** (a) | **5.** (c) |
| **6.** (b) | **7.** (d) | **8.** (b) | **9.** (c) | **10.** (c) |
| **11.** (d) | **12.** (c) | **13.** (c) | **14.** (d) | **15.** (a) |
| **16.** (c) | **17.** (b) | **18.** (c) | **19.** (a) | **20.** (d) |
| **21.** (c) | **22.** (c) | **23.** (b) | **24.** (b) | **25.** (d) |
| **26.** (c) | **27.** (d) | **28.** (d) | **29.** (b) | **30.** (c) |
| **31.** (d) | **32.** (a) | **33.** (c) | **34.** (b) | **35.** (b) |
| **36.** (d) | **37.** (d) | **38.** (b) | **39.** (d) | **40.** (b) |
| **41.** (c) | **42.** (b) | **43.** (5) | **44.** (51) | **45.** (17) |
| **46.** (12) | **47.** (540) | **48.** (210) | **49.** (9) | **50.** (252) |
| **51.** (5) | **52.** (5) | **53.** (1120) | **54.** (60) | **55.** (41) |

### EXERCISE - 2 : PREVIOUS YEAR JEE MAIN QUESTIONS

| | | | | |
|---|---|---|---|---|
| **1.** (c) | **2.** (a) | **3.** (a) | **4.** (d) | **5.** (a) |
| **6.** (a) | **7.** (c) | **8.** (a) | **9.** (b) | **10.** (b) |
| **11.** (24) | **12.** (b) | **13.** (d) | **14.** (b) | **15.** (c) |
| **16.** (a) | **17.** (84) | **18.** (b) | **19.** (c) | **20.** (8) |
| **21.** (b) | **22.** (a) | **23.** (100) | **24.** (a) | **25.** (d) |
| **26.** (0) | **27.** (c) | **28.** (d) | **29.** (c) | **30.** (d) |
| **31.** (b) | **32.** (b) | **33.** (118) | **34.** (c) | **35.** (c) |
| **36.** (8) | **37.** (c) | **38.** (13) | **39.** (120) | **40.** (b) |
| **41.** (d) | **42.** (30) | **43.** (b) | **44.** (b) | **45.** (615) |
| **46.** (a) | **47.** (51) | **48.** (c) | **49.** (21) | **50.** (d) |
| **51.** (a) | **52.** (210) | **53.** (1) | **54.** (a) | **55.** (d) |
| **56.** (b) | **57.** (96) | **58.** (8) | **59.** (d) | **60.** (a) |
| **61.** (a) | **62.** (55) | **63.** (98) | **64.** (924) | **65.** (49) |
| **66.** (b) | **67.** (b) | **68.** (15) | **69.** (55) | **70.** (315) |
| **71.** (6) | **72.** (b) | **73.** (d) | **74.** (4) | **75.** (4) |
| **76.** (210) | **77.** (19) | **78.** (c) | **79.** (b) | **80.** (12) |
| **81.** (d) | **82.** (1) | **83.** (b) | **84.** (45) | **85.** (b) |

## CHAPTER -12 | BINOMIAL THEOREM

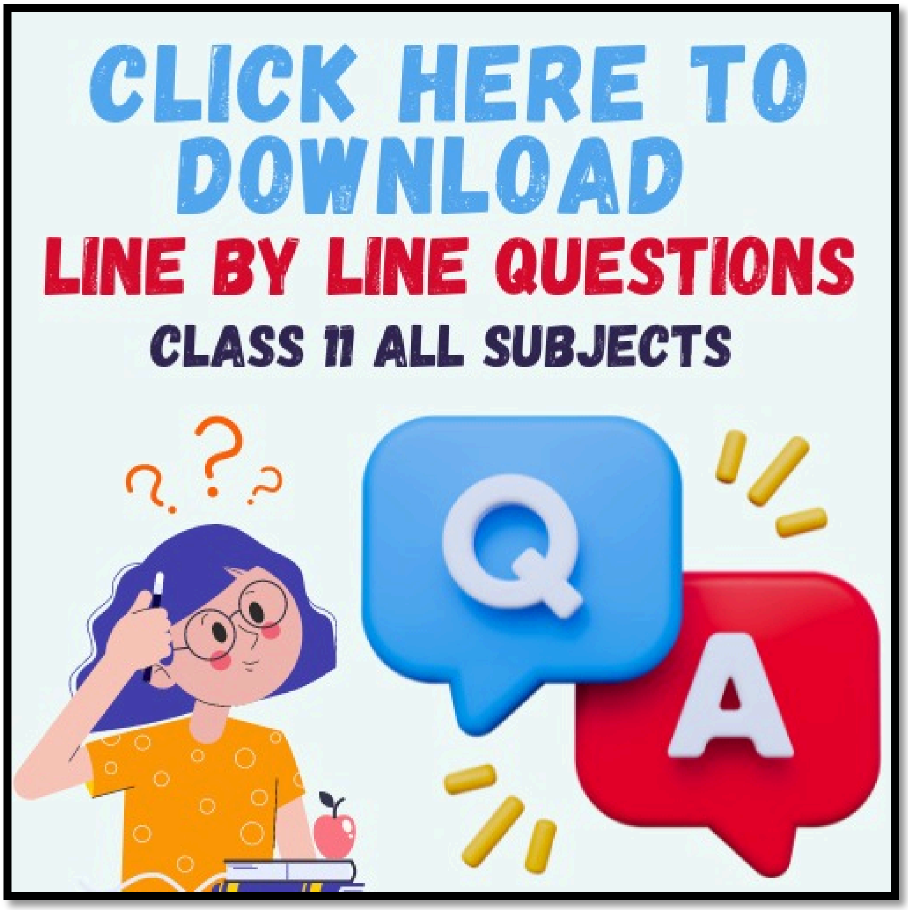
### EXERCISE - 3 : ADVANCED OBJECTIVE QUESTIONS

| | | | | |
|---|---|---|---|---|
| **1.** (b) | **2.** (c) | **3.** (a) | **4.** (a) | **5.** (b) |
| **6.** (c) | **7.** (c) | **8.** (b) | **9.** (c) | **10.** (a) |
| **11.** (d) | **12.** (c) | **13.** (a) | **14.** (c) | **15.** (b) |
| **16.** (c) | **17.** (a) | **18.** (b) | **19.** (b) | **20.** (b) |
| **21.** (b) | **22.** (a) | **23.** (c) | **24.** (a) | **25.** (b) |
| **26.** (c) | **27.** (a) | **28.** (c) | **29.** (a) | **30.** (a) |
| **31.** (c) | **32.** (c) | **33.** (c) | **34.** (b) | **35.** (a,b) |
| **36.** (a,c,d) | **37.** (a,c) | **38.** (3) | **39.** (5.06) | **40.** (34) |
| **41.** (5.50) | **42.** (-5050) | | **43.** (a) | **44.** (d) |

**47.** $\frac{2^{mn}-1}{2^{mn}(2^n-1)}$

### EXERCISE - 4 : PREVIOUS YEAR JEE ADVANCED QUESTIONS

| | | | | |
|---|---|---|---|---|
| **1.** (d) | **2.** (b) | **3.** (c) | **4.** (d) | **5.** (d) |
| **6.** (c) | **7.** (d) | **8.** (c) | **9.** (6) | **10.** (8) |
| **11.** (5) | **12.** (646) | **13.** (6.20) | | |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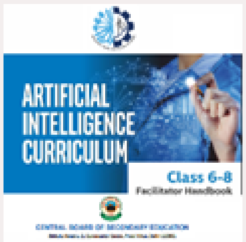

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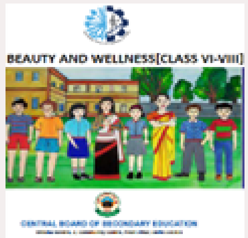

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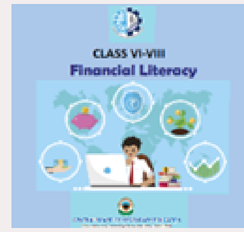
Design Thinking & Innovation



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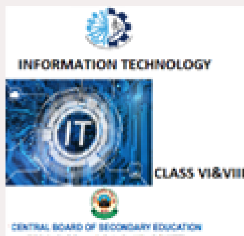

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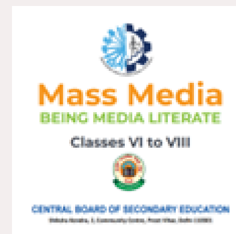

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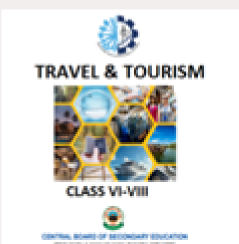

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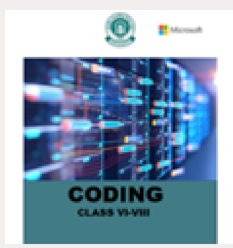

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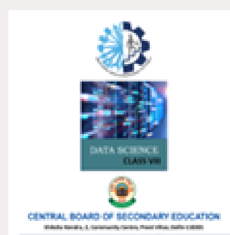

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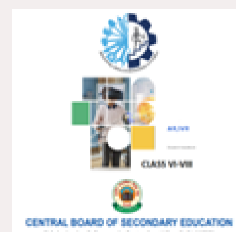

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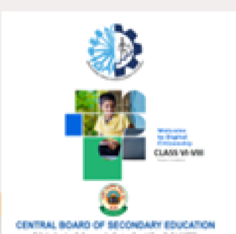

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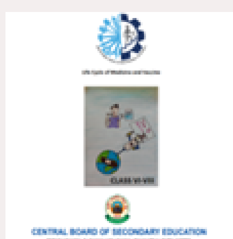
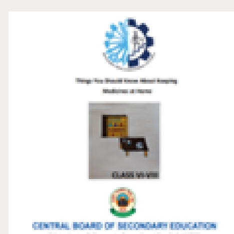
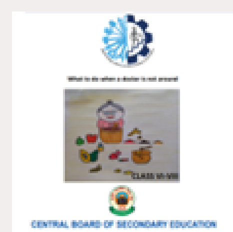


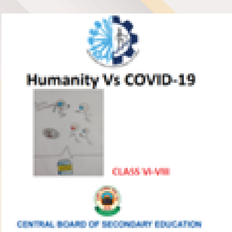
Life Cycle of Medicine & Vaccine



Things you should know about keeping Medicines at home



What to do when Doctor is not around



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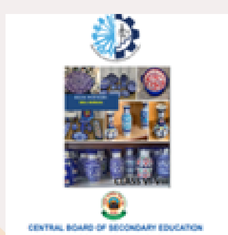
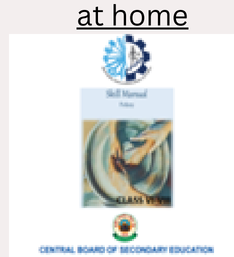
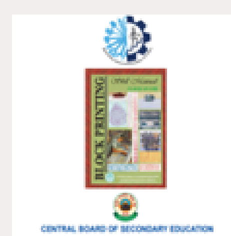


Blue Pottery



Pottery



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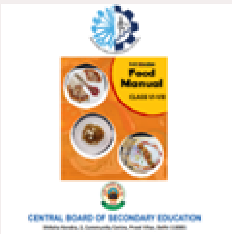
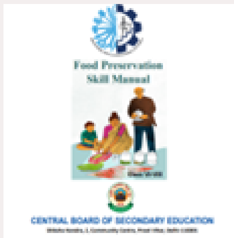
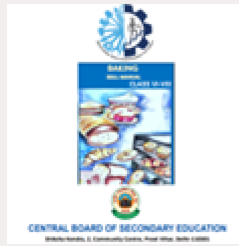


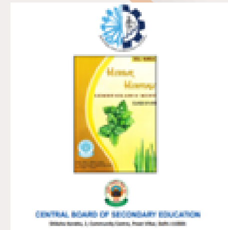
Food



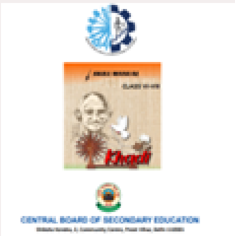

Food Preservation



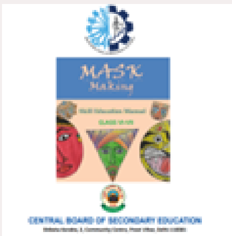
Baking



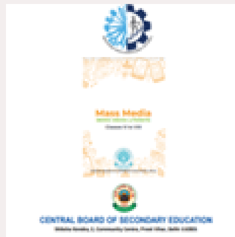
Herbal Heritage



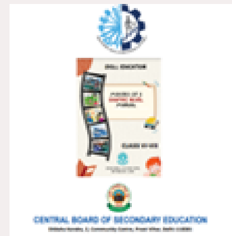
Khadi



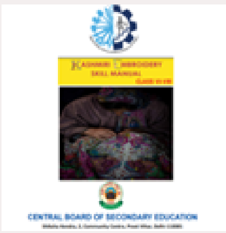

Mask Making



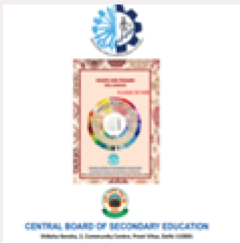
Mass Media



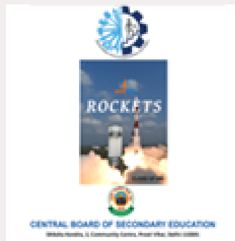
Making of a Graphic Novel



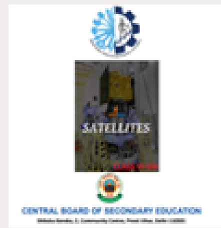
Kashmiri Embroidery



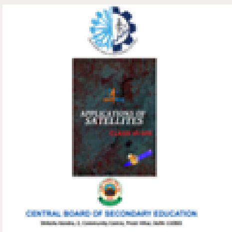
Embroidery



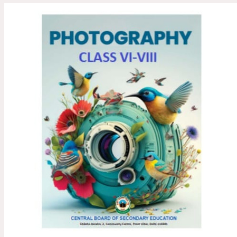

Rockets




Satellites

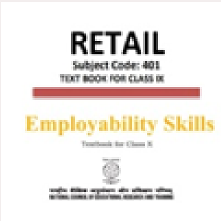


Application of Satellites



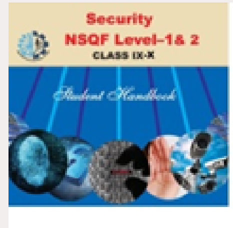

Photography

# SKILL SUBJECTS AT SECONDARY LEVEL (CLASSES IX – X)

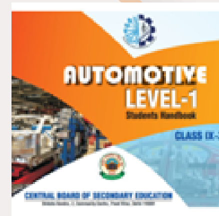



Retail

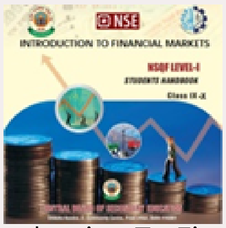

Information Technology



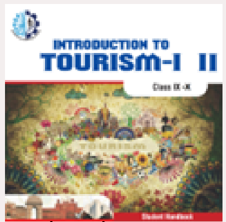

Security



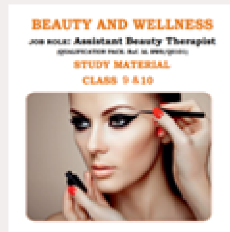

Automotive



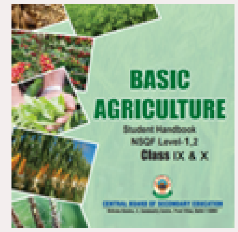

Introduction To Financial Markets



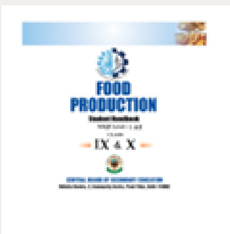

Introduction To Tourism



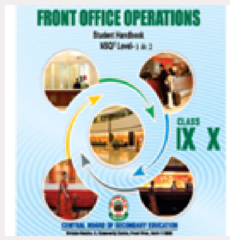

Beauty & Wellness



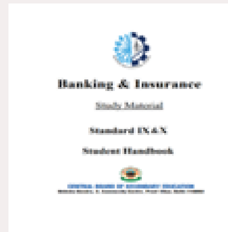

Agriculture




Food Production

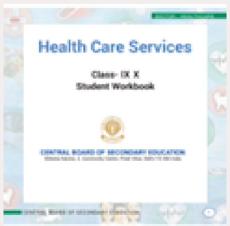



Front Office Operations



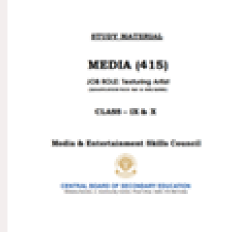

Banking & Insurance


Marketing & Sales

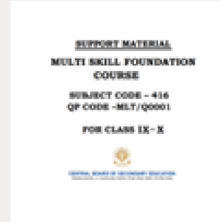



Health Care

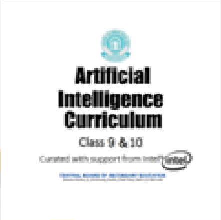

Apparel



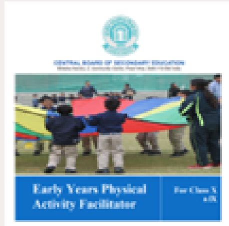

Multi Media



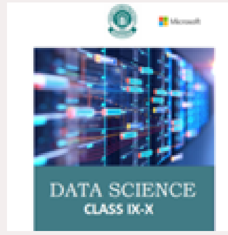

Multi Skill Foundation Course




Artificial Intelligence

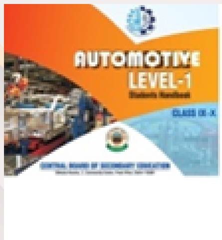



Physical Activity Trainer

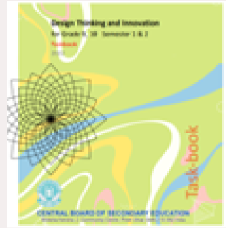



Data Science


Electronics & Hardware (NEW)

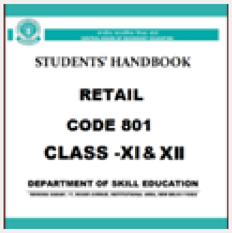



Foundation Skills For Sciences (Pharmaceutical & Biotechnology)(NEW)

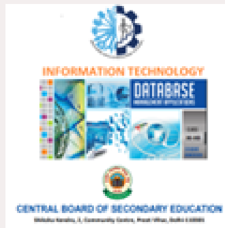



Design Thinking & Innovation (NEW)

# SKILL SUBJECTS AT SR. SEC. LEVEL (CLASSES XI – XII)

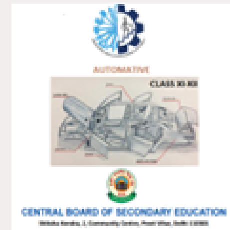


Retail



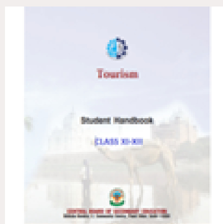
InformationTechnology

Web Application

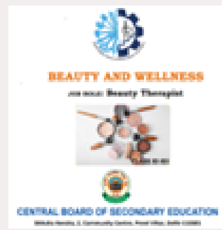


Automotive

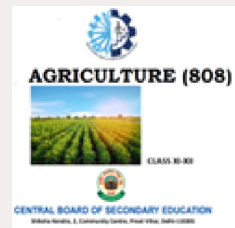
Financial Markets Management



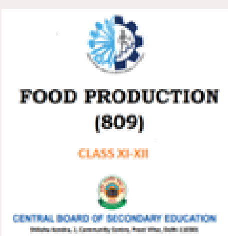
Tourism



Beauty & Wellness

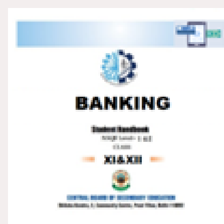


Agriculture

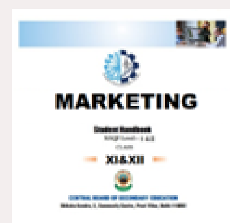


Food Production

Front Office Operations

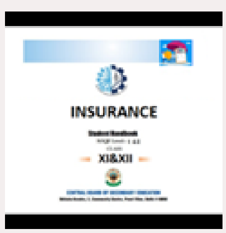


Banking

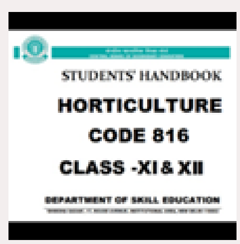


Marketing

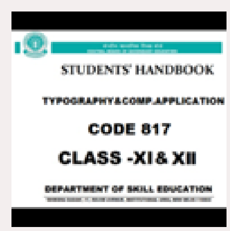
Health Care



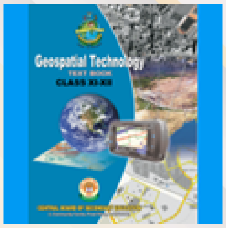
Insurance



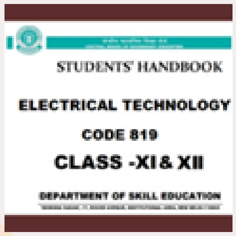
Horticulture



Typography & Comp. Application

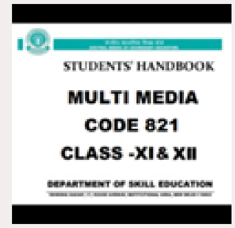


Geospatial Technology

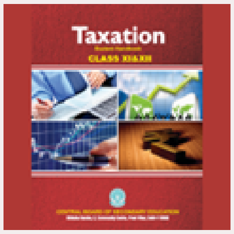


Electrical Technology

Electronic Technology

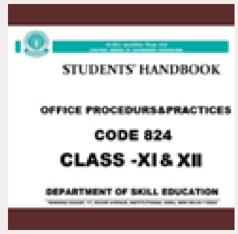


Multi-Media

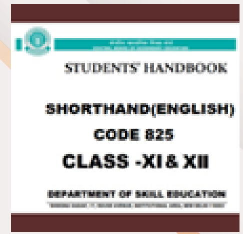


Taxation

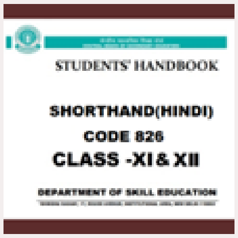
Cost Accounting



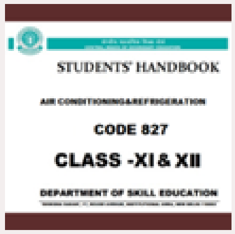
Office Procedures & Practices



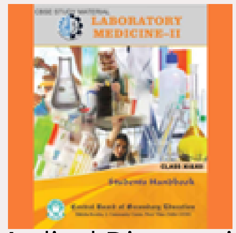
Shorthand (English)



Shorthand (Hindi)

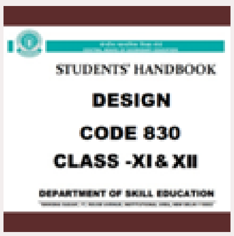


Air-Conditioning & Refrigeration

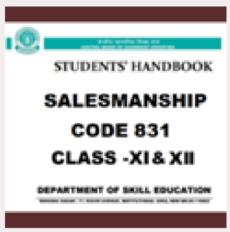


Medical Diagnostics

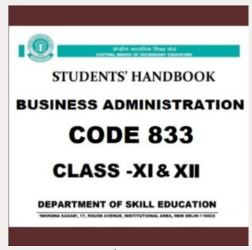
Textile Design



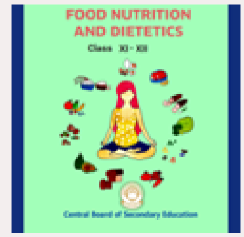
Design



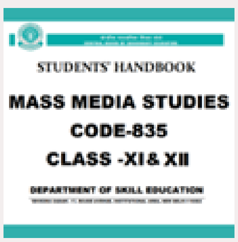
Salesmanship



Business Administration

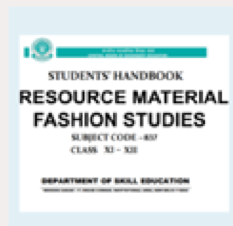


Food Nutrition & Dietetics

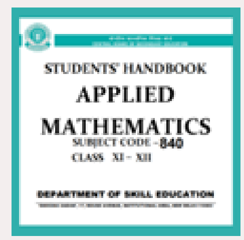


Mass Media Studies

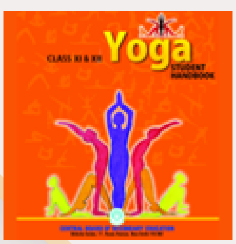
Library & Information Science



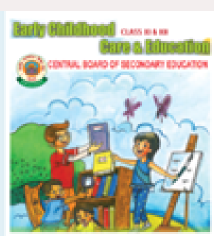
Fashion Studies



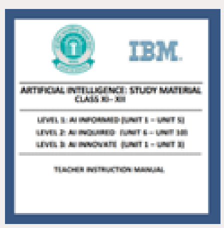
Applied Mathematics



Yoga

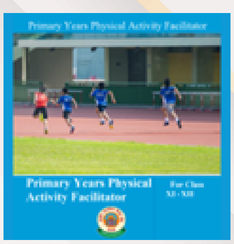


Early Childhood Care & Education

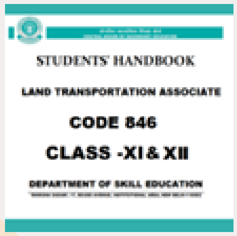


Artificial Intelligence

Data Science



Physical Activity Trainer(new)



Land Transportation Associate (NEW)

Electronics & Hardware (NEW)

Design Thinking & Innovation (NEW)